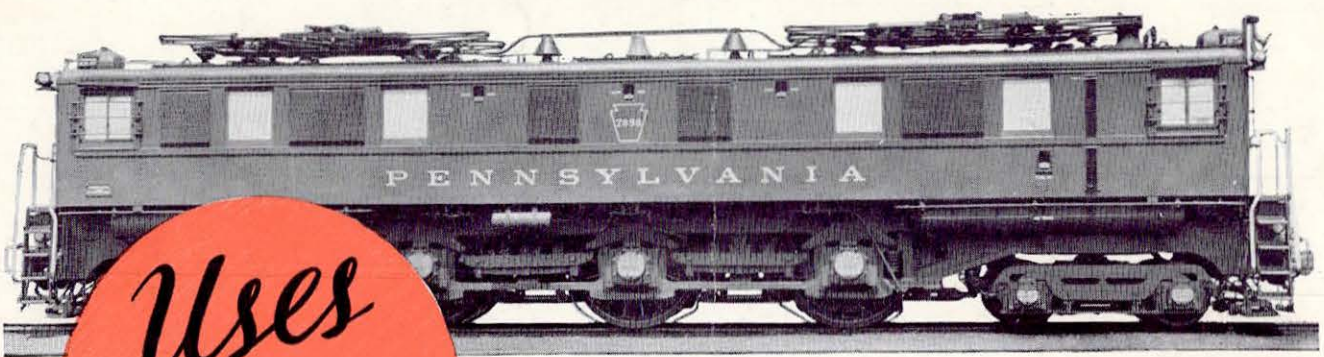
FEBRUARY 25, 1933

Railway Age

Founded In 1856

PENNSYLVANIA RAILROAD



Uses BYERS PIPE for New Electric Locomotives

One of the new electric locomotives of the Pennsylvania Railroad which is equipped with Byers Pipe.

ANOTHER milestone in transportation has been passed as the Pennsylvania Railroad inaugurates its electrification between New York and Philadelphia.

The Pennsylvania Railroad used wrought iron pipe, meeting its general specifications for pipe, in constructing its fleet of new electric locomotives.

The many years of actual service during which wrought iron has proved its superiority in retarding corrosion and resisting fatigue caused by sudden shock or constant vibration has spread the conviction that wrought iron gives longer, more reliable and economical service.

For sixty-nine years Byers Genuine Wrought Iron has been a railroad standby and so it is only natural that double-strength wrought iron pipe should have met the railroad specifications for pipe to be used in the coils of the compact steam units of the new electric locomotives as well as for the air-brake piping. A. M. Byers Company are the originators and only manufacturers of Genuine Wrought Iron Bending Pipe.

At your request, a Byers engineer will tell you about special bending pipe and will arrange to demonstrate in your own shops the economies that the use of this new development can bring.

A. M. Byers Company, Established 1864. Pittsburgh, Boston, New York, Philadelphia, Chicago, St. Louis, Houston, Los Angeles.

BYERS GENUINE WROUGHT IRON PRODUCTS

PIPE · WELDING FITTINGS · RIVETS · SPECIAL BENDING PIPE · BAR IRON
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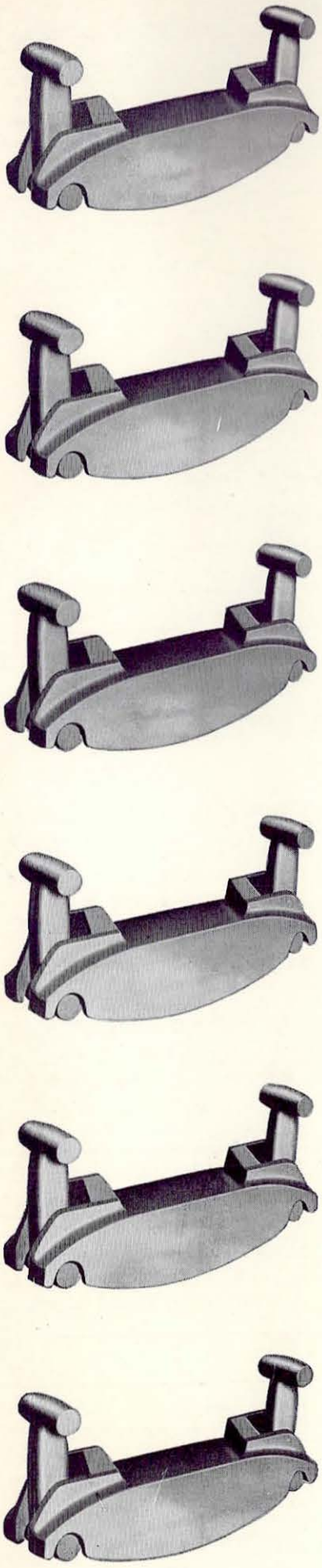
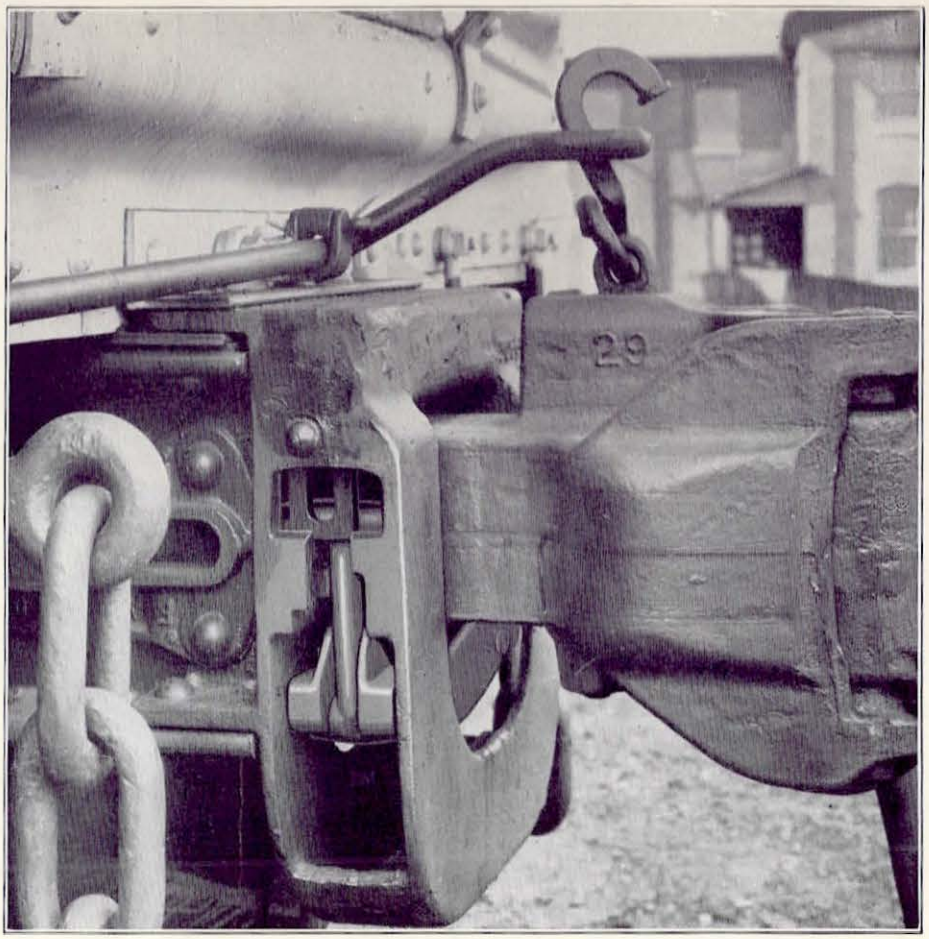
STANDARD of QUALITY for 69 YEARS BYERS 1864 GENUINE WROUGHT IRON • • • TODAY BETTER THAN EVER





Safety First

The gravity carry iron of the Union Centering Device returns the coupler to its normal central position. This provides a safety feature well worthy of consideration.

UNION METAL PRODUCTS COMPANY

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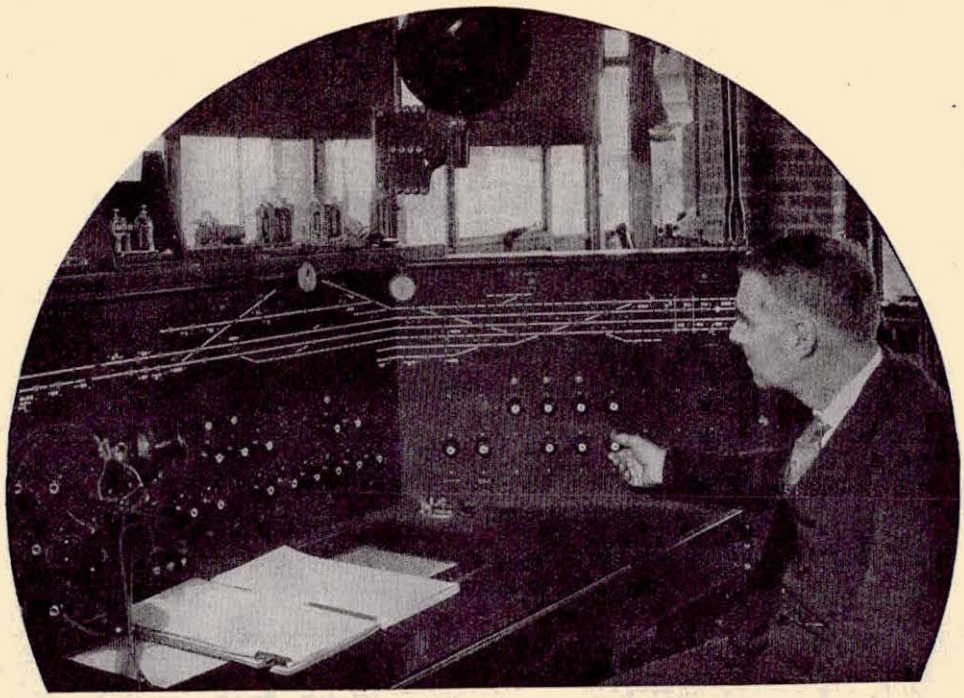
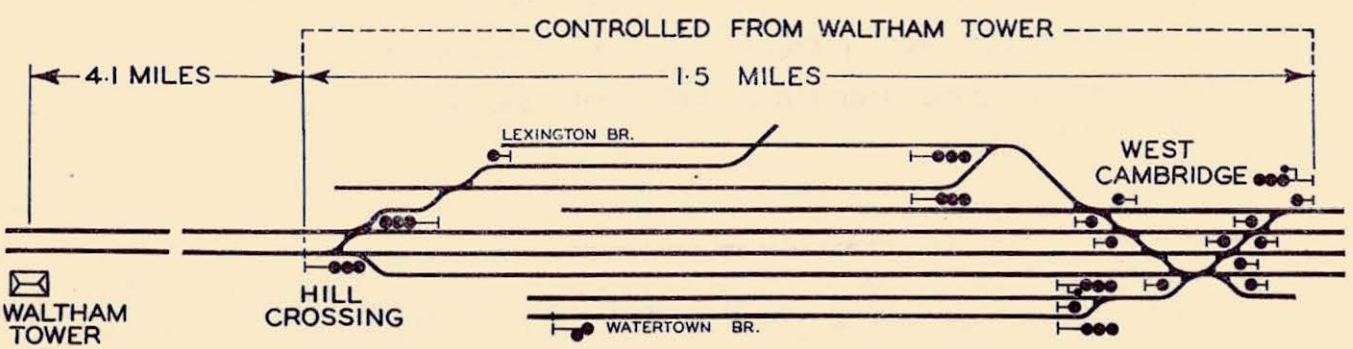


B. & M. ACHIEVES ECONOMIES BY INTERLOCKING CONSOLIDATION

Confronted with the necessity of rebuilding the old, worn-out mechanical interlocking plant at West Cambridge, the B. & M. officials made an intensive study of the situation and finally decided to control the switches and signals of that plant from the interlocking tower at Waltham, about $5\frac{1}{2}$ miles to the west, by means of the G-R-S Coded Remote-Control System.

RESULT—One less interlocking station to operate and maintain as well as increased operating facilities and savings.

It will pay YOU to investigate the many possibilities of G-R-S Remote-Control Interlocking. Ask your signal engineer about it.



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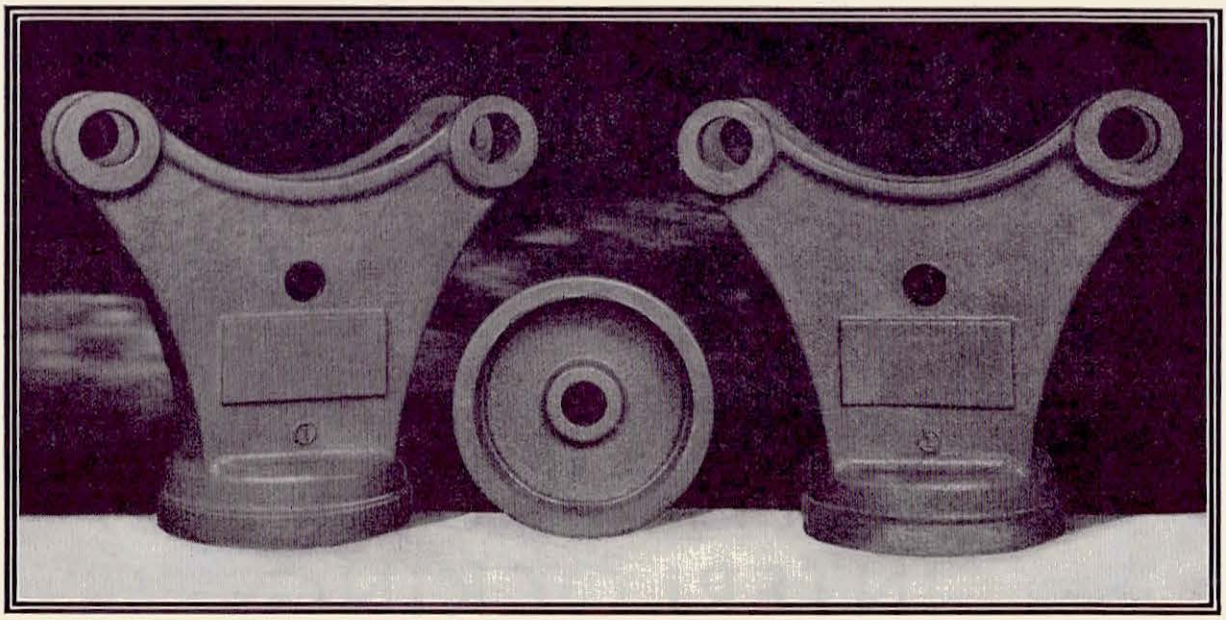
CONTRIBUTING TO THE SUCCESS OF THE PENNSYLVANIA ELECTRIFICATION PROJECT



Two of the cast steel center castings shown in the illustration were used on each of the Pennsylvania new electric locomotives.

These important castings weigh about 600 pounds each and must meet rigid specifications and conform accurately with drawing dimensions.

Through more than a third of a century of service, in hundreds of different uses and through constant and rigid laboratory tests, the American Steel Foundries is able to offer cast steel products of quality, dependability and performance standards that invite the most exacting comparison.

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The Railway Age is indexed by the Industrial Arts Index and also by the Engineering Index Service

When 40 SECONDS mean a MILE

there is no time for guesswork!

Human lives and costly properties are at stake. Train crews and others engaged in the movement of trains must know their business. And—they DO! Equipment *must* be sound—and it IS! That's why rail travel is the safest—by a huge margin.

The selection of *air conditioning* equipment involves no such tremendous responsibility. Human lives are not at stake. *But car-mile operating cost is.* Now is *that* a vital problem to railway executives, particularly in times like these? We leave the answer to you.

The **P C & M C** *Air Conditioning* system is *not* the result of overnight reflection. No *real achievement* ever is. It is the product of years of thorough engineering research—applied to a background of more than 75 years of railroading experience. Built for railroading conditions—*by men who know them.*

No other system is as economical to operate; none as simple mechanically. Your further consideration of these and other operating advantages is invited on a basis of our ability to show why **P C & M C** installations deliver the best financial return of any *air conditioning* equipment.

P C & M C OPERATING ADVANTAGES

1 Other systems of equivalent capacity absorb *30% to 67% more locomotive power* than **P C & M C.**

2 **P C & M C** system has *fewer moving parts*, which assures dependable simplicity.

3 Other systems are *50% to 110% heavier* in weight than **P C & M C.**

4 **P C & M C** installation is backed by *7 years of engineering research*—plus 5 million car miles of actual operating experience.

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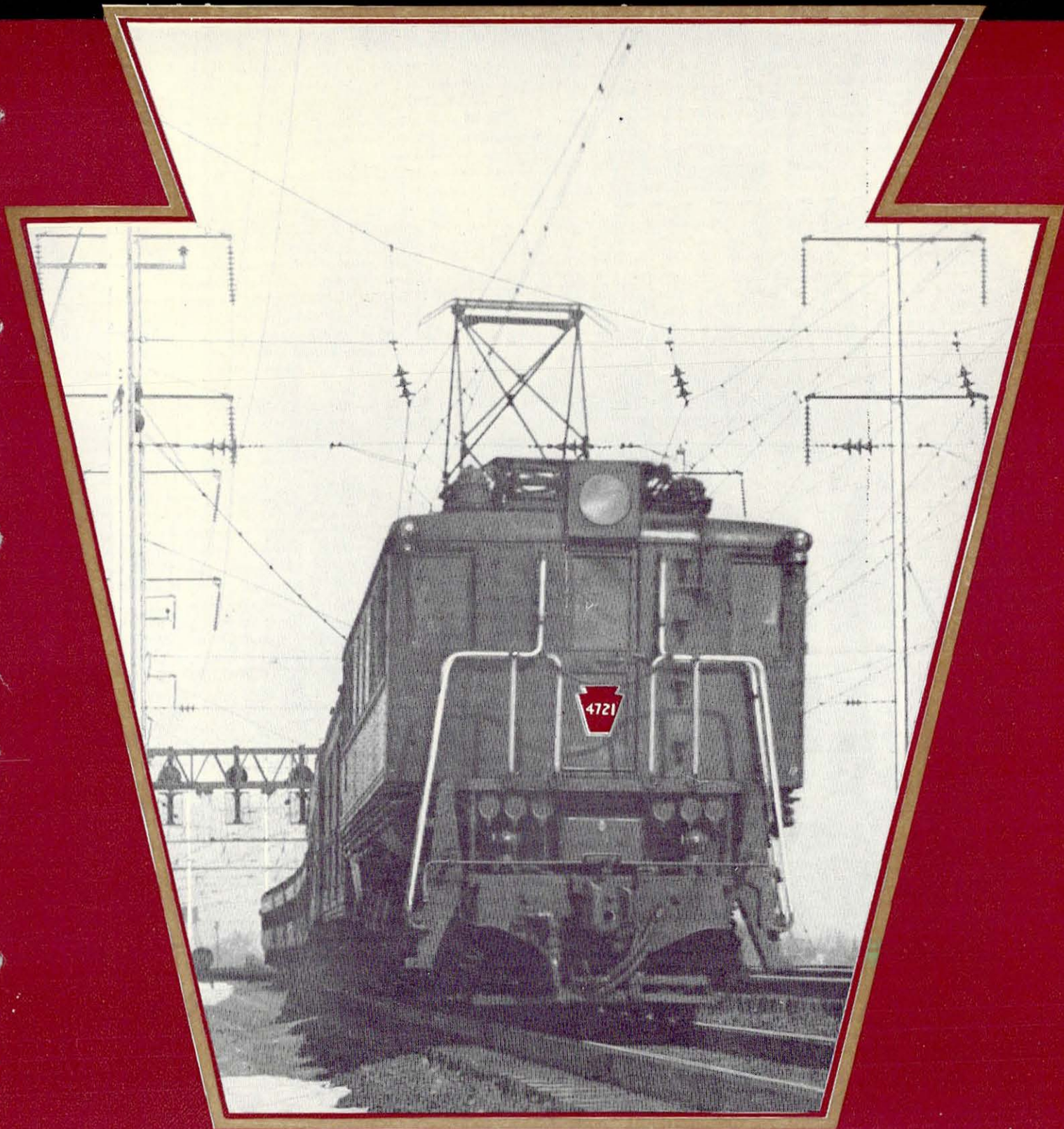
PENNSYLVANIA ELECTRIFICATION



INAUGURATION of electric train service between New York, Philadelphia and Wilmington marks the completion of an important portion of the $100,000,000 electrification program to cover both passenger and freight train service between the Pennsylvania Railroad's eastern terminals. It will ultimately embrace in its entirety all train service between New York, Philadelphia, Baltimore and Washington.

The Pennsylvania Electrification, the most comprehensive installation of this nature in the country, will provide improved service to the most densely populated area, serving approximately 18,000,000 people or about 15 per cent of the population of the United States.

The electrification and terminal improvements are a lasting tribute to the foresight of the Pennsylvania management. They are an expression of its confidence in the stability of the railway industry and exemplify vision as to the future transportation needs of this country.

The Pennsylvania Railroad is to be congratulated for initiating this great forward step in transportation and for its splendid courage in carrying this prodigious project through the present period of economic strife.

The project is notable for its excellence in engineering design, for many new engineering achievements and for the development of a large variety of new equipment, all of which help to achieve definite economies in operation and to give improved service to the public. In recognition of these facts, the *Railway Age* presents a comprehensive review of the important work of the railroad, the engineers and contractors, and an exhibit of appliances and materials produced by many of America's foremost manufacturers who, like the Pennsylvania, are continually striving to build better that the railways may serve better.

PENNSYLVANIA RAILROAD ELECTRIFICATION

VARE CONSTRUCTION COMPANY, INC.

ENGINEERS AND CONTRACTORS

PHILADELPHIA, PA.

Electrification Contracts for the Pennsylvania Railroad Executed by this Company:

Philadelphia to Trenton—Total Installation

Philadelphia to Norristown—Total Installation

* Wilmington to Baltimore—Total Installation except Underground Conduits and Foundations south of Perryville

Trenton to Wilmington—Through Power Supply

Richmond Step-up Station and Transmission Lines to Frankford Junction and Tacony

Philadelphia to Paoli—Transmission Lines and Improvements for Through Operation

"Total Installation" covers the complete operation of electrifying, including underground conduits, concrete foundations, erection of steel, stringing all wires, transmission lines, and erection of structures and installation of all equipment and wires in substations.

* Incomplete—Still under contract.

KEYSTONE STATE
CORPORATION

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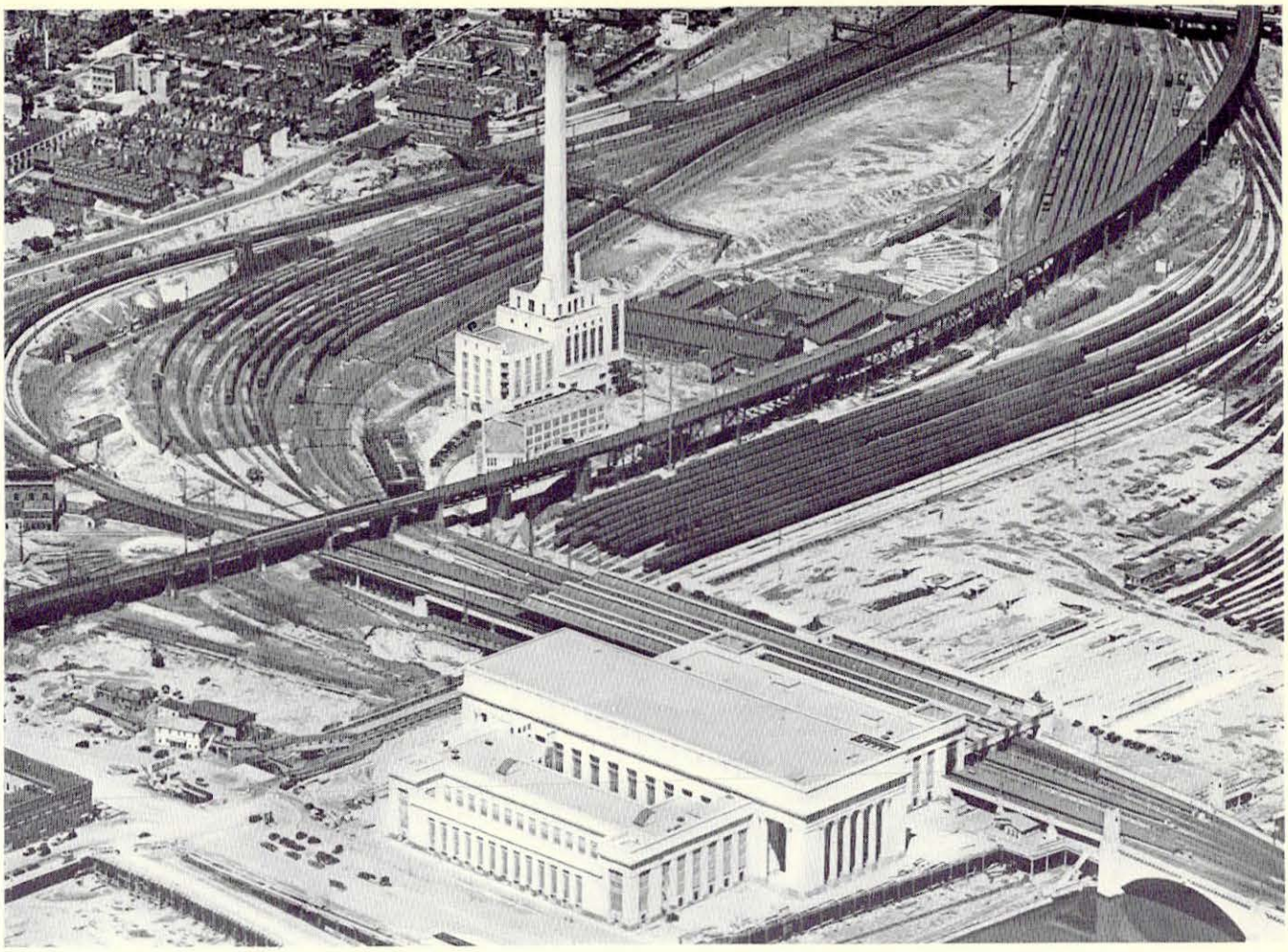


The Pennsylvania Railroad Philadelphia Improvements

UNITED Engineers & Constructors Inc., during the past five years has constructed the following important units in the Philadelphia Passenger Terminal Program:

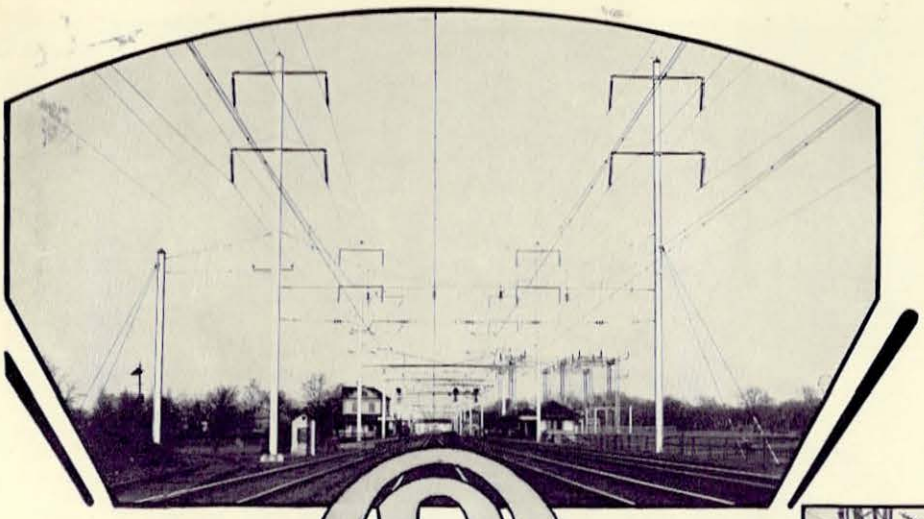
Pennsylvania Station, 25 million cubic feet, now under construction
Central Steam Heating Plant and Distribution System, peak steaming capacity of present installation 500,000 pounds per hour
Freight Station, seven stories, 10 million cubic feet
Yard Service Building, three stories, 500,000 cubic feet
Electrical Distribution Duct System, for light and power, telephone and telegraph, signals and interlocking
Coach Yards, including steam, water, air and other facilities
Terminal track work Catenary Work, Terminal Zone

Graham, Anderson, Probst & White, architects for the Pennsylvania Station and the Central Steam Heating Plant.

UNITED ENGINEERS & CONSTRUCTORS INC.

PHILADELPHIA NEW YORK NEWARK BOSTON CHICAGO LOS ANGELES

MAXIMUM RETURN TO CLIENTS PER DOLLAR EXPENDED



Duplicate transmission lines provide positive assurance of continuous power on the Pennsylvania electrification. Thousands of O-B Suspension Insulators are in service.

A TRIBUTE *to Foresight-* AN EXPRESSION *of Confidence*

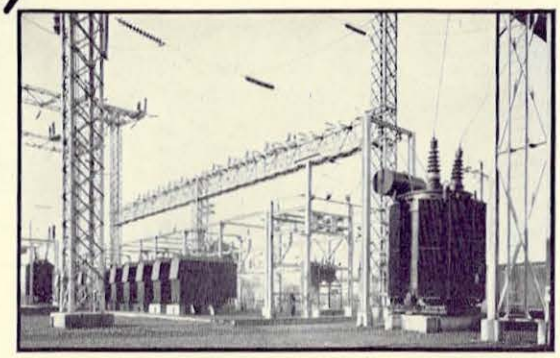
THE huge project of electrification, now being completed by the Pennsylvania Railroad, is a tribute to the foresight of the road's management. It is an expression of their confidence in the stability and future growth of the country.

The successful completion of such an undertaking requires unusual engineering skill, because many innovations are introduced in this railroad electrification. And the manner in which the complex problems are solved, stands as an indelible credit to the tireless efforts of the engineers who will make this entire electrification a reality.

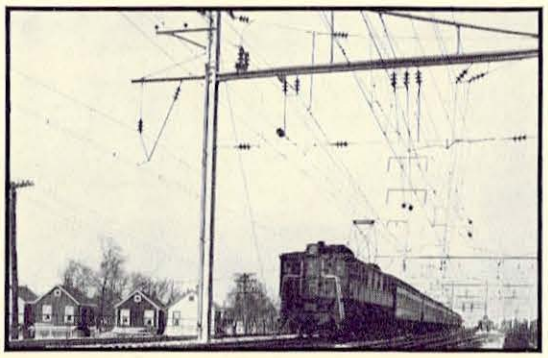
As in previous electrifications of the Pennsylvania, O-B materials are also found in this extended project. Not only are products bearing the well-known O-B trademark used on the Pennsylvania, but they are also found on most every electrification.

In building for the future, those who will some day apply the benefits of electrification to other transportation projects, may well record O-B as being a desirable source of supply; because designing and manufacturing insulating, suspending and bonding materials for steam road electrification is the work to which O-B brings a rich background of experience.

1595H



Sub-stations are placed about seven miles apart along the right-of-way. Many O-B oil-filled apparatus bushings are in service in these stations.



Locomotives develop the previously unheard of value of 1250 hp. per axle, and are capable of speeds of 90 miles per hour.

Other electrifications in which O-B materials are used:

Chicago, Milwaukee, St. Paul and Pacific
Cleveland Union Terminal
Delaware, Lackawanna and Western
Baltimore and Ohio
New York Central
Reading Railroad
Illinois Central
Great Northern
New York, New Haven and Hartford
Canadian National
Western Pacific

OHIO BRASS COMPANY

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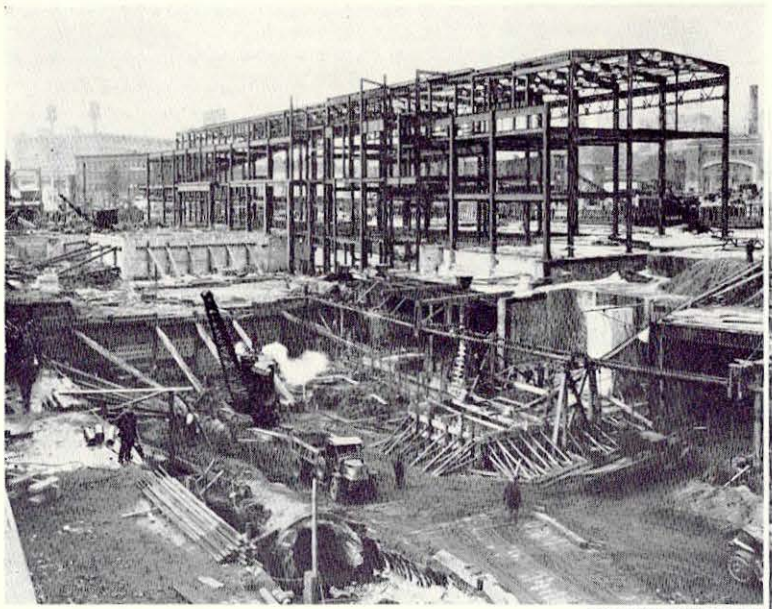


NEW MARKET STREET STATION

of the

Pennsylvania Railroad Company

Newark, N. J.

Together with new Passaic River Bridges, Elevated Viaduct and City Subway Loop

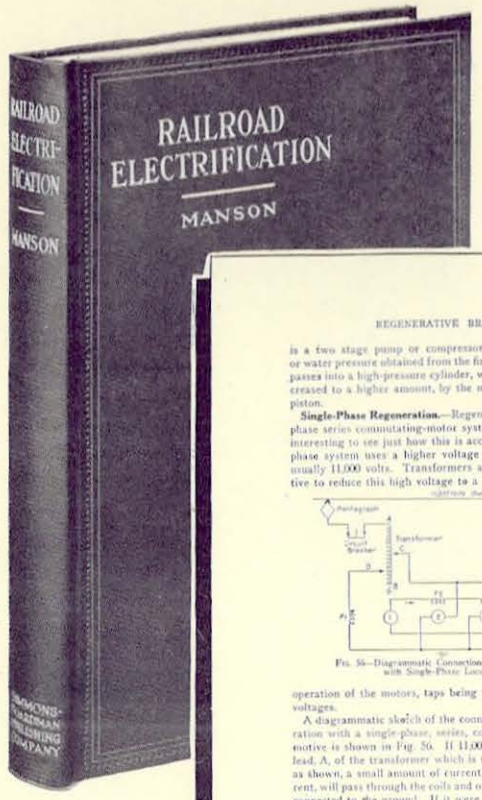
By

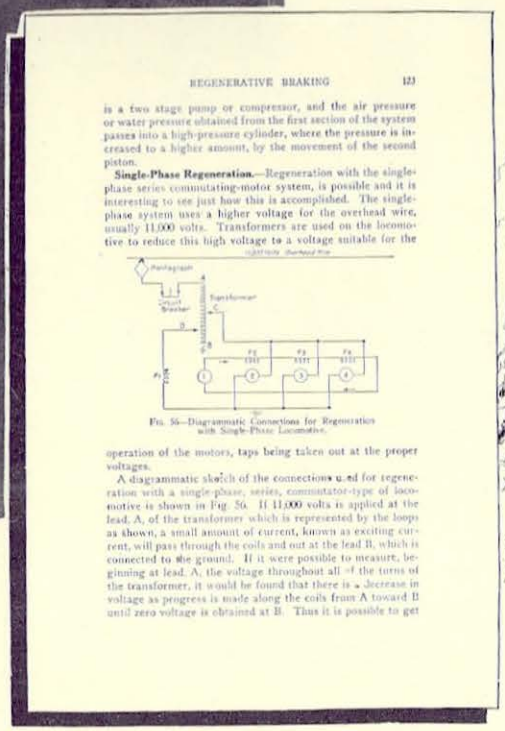
J. RICH STEERS, INC.

17 BATTERY PLACE, NEW YORK, N. Y.

GENERAL CONTRACTORS

Railroad Electrification and the Electric Locomotive





REGENERATIVE BRAKING 123

is a two stage pump or compressor, and the air pressure or water pressure obtained from the first section of the system passes into a high-pressure cylinder, where the pressure is increased to a higher amount, by the movement of the second piston.

Single-Phase Regeneration.—Regeneration with the single-phase series commutating-motor system, is possible and it is interesting to see just how this is accomplished. The single-phase system uses a higher voltage for the overhead wire, usually 11,000 volts. Transformers are used on the locomotive to reduce this high voltage to a voltage suitable for the

Fig. 56—Diagrammatic Connections for Regeneration with Single-Phase Locomotive

operation of the motors, taps being taken out at the proper voltages.

A diagrammatic sketch of the connections used for regeneration with a single-phase, series, commutator-type of locomotive is shown in Fig. 56. If 11,000 volts is applied at the lead A, of the transformer which is represented by the loops as shown, a small amount of current, known as exciting current, will pass through the coils and out at the lead B, which is connected to the ground. If it were possible to measure, beginning at lead A, the voltage throughout all of the turns of the transformer, it would be found that there is a decrease in voltage as progress is made along the coils from A toward B until zero voltage is obtained at B. Thus it is possible to get

2nd Edition, 332 pages, 148 illustrations cloth, 6 x 9, $3.00

By Arthur J. Manson

Assistant Sales Manager, Transportation Department, Westinghouse Electric & Manufacturing Company

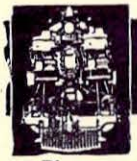
Electrification has been proceeding slowly in spite of the depression. Because of greater horsepower and more serviceability hours a day, one electric is the equivalent of two steam locomotives.

While few roads are at present in a position to make large capital expenditures required for new electrification projects, there is no retrogression in this field. Expansion of electrification continues.

This book covers the theory, design, construction, care and operation of electric locomotives, and their application to all classes of railroad service. It is written by an authority in untechnical language. It is sound enough for the expert yet can be understood by the man who has only a general knowledge of the subject. A set of solutions to typical problems met with in electrification plans is included.

CONTENTS

Advantages of Electrification—Electrical Terms and Their Relation to Mechanics—Ohm's Law—Inductance and Capacity—The Generation of the Electric Current—The Electric Motor—The Alternating-Current Single Phase Motor—The Three-Phase Motor—Railway Motor Characteristic Curves—Motor Combinations for Speed Control—General Principles Relating to the Operation of Trains—Comparison of the Operating Characteristics of Steam and Electric Locomotives—Methods Used for Accelerating Electric Locomotives—Energy Losses Incurred by the Various Methods of Acceleration—Regenerative Braking with Electric Locomotives—The Air Brake Equipment for the Electric Locomotive—Electric Locomotive Design—The Pantagraph—The Third-Rail Shoe—The Transformer and Auxiliary Apparatus—The Control Apparatus—Construction of the Modern Railway Motor—Mechanical Design of the Electric Locomotive—Inspection and Maintenance—The Speed-time Curve—The Continuous Speed-Time Curve and Train Chart—Gear Ratio and Wheel Diameter—An Electrification Problem—Electrification System of the Future—A Brief Survey of Electrification in the United States.



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Who's Who in Railroading

The new edition of what was formerly the "Biographical Directory of Railway Officials of America" covers all of North America including Cuba. Biographical sketches of some 4,000 railroad officials, equipment manufacturers, economists, members of regulatory commissions and others whose work is directly connected with the railroad industry are included. The information is based upon original questionnaires. Since 1885 this book has been recognized as the standard authority on who's who in the railroad field.

Ninth edition. 579 pages, 6 x 9 inches, $3.00.

Car Lighting by Electricity

By CHARLES W. T. STUART

Foreman of Car Lighting, Philadelphia Terminal, Pennsylvania Railroad

The only book covering car lighting in accordance with modern practice. The general principles involved in installation and operation of the various systems are carefully explained. All the tools and appliances used in maintenance are described. Includes the specifications covering the car lighting Standards and Recommended Practices of the American Railway Association.

366 pages, 256 illustrations, cloth, 6 x 9, $3.00

FAITH *in the* FUTURE

A PROGRESSIVE RAILROAD SETS AN INSPIRING EXAMPLE . . . .

FOR over fifty years Westinghouse has been prominently identified with the development of railway equipment. To the constant improvement of electrical apparatus in its many applications to railroads, Westinghouse has devoted its full resources of research, engineering and manufacture.

It is, therefore, a source of great satisfaction to Westinghouse to have been privileged to cooperate closely with the Pennsylvania Railroad in the planning and execution of its New York to Philadelphia electrification program that was recently completed.

Westinghouse congratulates the Pennsylvania Railroad on its far-sighted and progressive policy—concrete evidence of its faith in the future—which should serve as an inspiration to American industry the country over.

This is a fitting time to review briefly on the following pages the history of the complete electrification program of the Pennsylvania Railroad, in all the phases of which Westinghouse has fully participated.

Highlights of WESTINGHOUSE FOR THE PENNSYLVANIA

Forerunner of New York Terminal Locomotives

Long Island Suburban Electrification

New York Terminal Electrification

Philadelphia to Paoli, Pa. Electrification

Experimental Freight Locomotive

Universal A-C. and D-C. Locomotives

1905—*Forerunner of New York Terminal Locomotives*

One of the first experimental locomotives built for the Pennsylvania in 1905. It was the forerunner of the New York Terminal locomotives placed in service in 1910. This particular locomotive, located at Sunnyside yards, is still available for regular duty.

1905—*Long Island Suburban Electrification*

The Long Island Division was one of the first railroads to be extensively electrified. The 650-volt third-rail system was used. Over 1000 cars are now in service.

1910—*New York Terminal Electrification*

Manhattan Transfer, where the change is made from steam to electric locomotives on trains to and from Pennsylvania Station. This electrification was an important factor in the successful solution of the New York Terminal problem. It made possible the use of tunnels under the North River for the purpose of reaching the heart of New York City.

1915—*Philadelphia to Paoli, Pa. Electrification*

The establishment of regular suburban service over the single-phase electrified zone at Philadelphia marked an important step in the electrification program of the Pennsylvania Railroad. At that time the electrified tracks extended only from the Broad Street Station to Paoli, 20 miles west on the main line. Since then, they have been extended to Norristown, Chestnut Hill, White Marsh and West Chester, Pa., Wilmington, Del., and Trenton, N. J.

1917—*Experimental Freight Locomotive*

With the prospect of extending main line electrification, and the possibility of electrifying the Altoona grade over the Allegheny Mountains, a 4000-horse-

DEVELOPMENTS ELECTRIFICATION . . .

power experimental locomotive was built. After completion of the tests, it was placed in regular freight service between Philadelphia and Paoli, Pa.

1924—*Universal A-C. and D-C. Locomotives for Freight and Passenger Service*

These "steeple" type cab locomotives were built for further experimental tests with the prospect of extending main line electrification. Motors were designed to be used interchangeably with either a-c. or d-c. control. By merely changing the gear ratio, the locomotives were applicable to either freight or passenger service.

Following the tests, these units were placed in regular service on the New York Terminal Division.

1926—*A-C. and D-C. Switching Locomotives*

Relief for crowded yards was obtained by the addition of new a-c. switchers for Philadelphia and d-c. switchers for Sunnyside, N. Y. At the same time the Long Island placed in service new a-c. switchers on their New York Connecting Division.

Motors on these units also can be used with either a-c. or d-c. control.

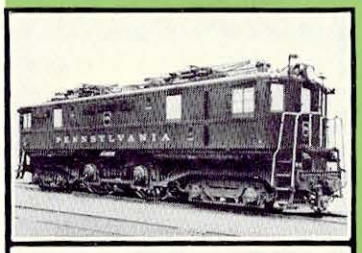
1931—*Pioneer Locomotives for Present Electrification*

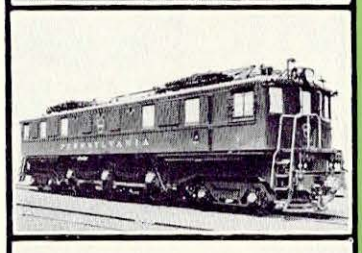
In view of plans for complete electrification between New York and Washington, experimental locomotives were built for three types of service—light passenger, heavy passenger, and freight. Identical motor windings and control were developed which are interchangeable in either type of engine, the only change being in motor frames and methods of mounting. Furthermore, these units were designed so that they can be used on any division of the railroad.

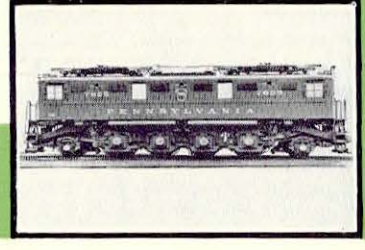
Universal A-C. and D-C. Locomotives (con't.)

D-C. Switching Locomotives

A-C. Switching Locomotives







Pioneer Locomotives For Present Electrification

Westinghouse

1933—NEW YORK—PHILADELPHIA ELECTRIFICATION

AND finally, here is the completed high-speed passenger locomotive selected by the Pennsylvania Railroad as standard for its entire electrified system.

Initial service between New York and Philadelphia was started January 16, 1933, marking the completion of an important part of the $100,000,000 electrification program.

The entire electrification program of the Pennsylvania Railroad represents 28 years of constructive planning that has always looked to the future. Westinghouse is proud to have played so important a part in this great saga of railroad progress.

Westinghouse

Quality workmanship guarantees every Westinghouse product

T 79467

Tune in the thrilling new Westinghouse mystery radio serial by OCTAVUS ROY COHEN . . . NBC Network

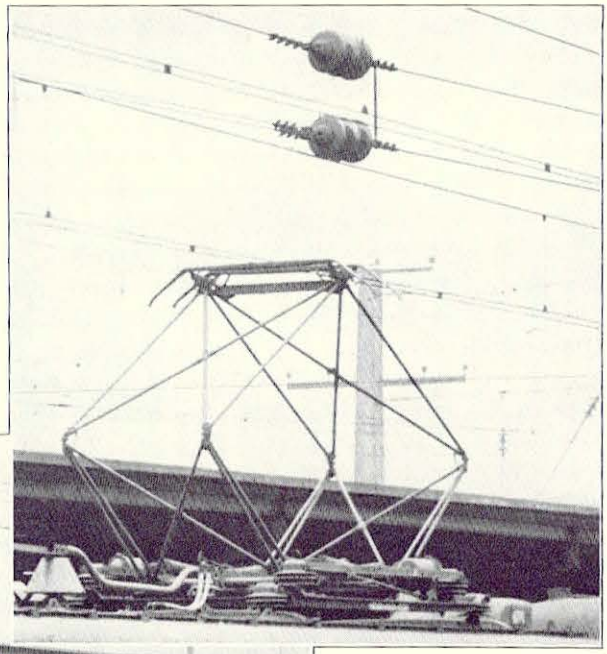
"Bridgeport" BRASS TRADE MARK CO.

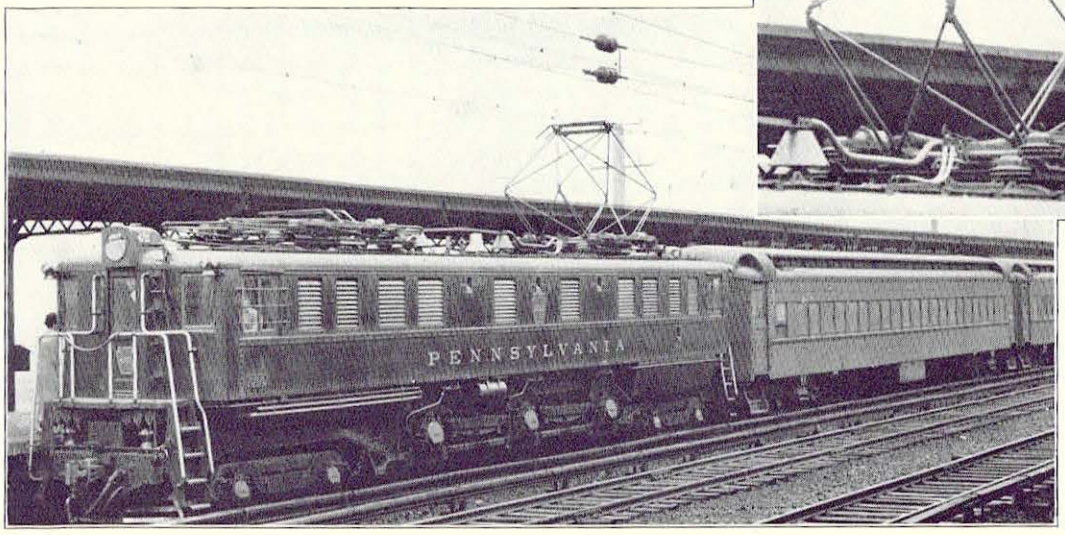
"PHONO-ELECTRIC" ALLOYS
DURONZE Bolts and Nuts

We are proud to be identified with the

PENNSYLVANIA RAILROAD

in its outstanding electrification program of railroad advancement.





"PHONO-ELECTRIC"

CONTACT WIRE MESSENGER WIRE HANGER RODS
CROSS AND BODY SPANS

DURONZE

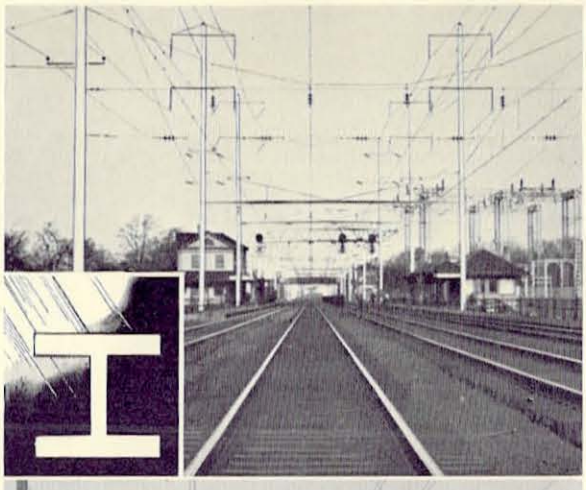
BOLTS AND NUTS TRU-LOC FITTINGS

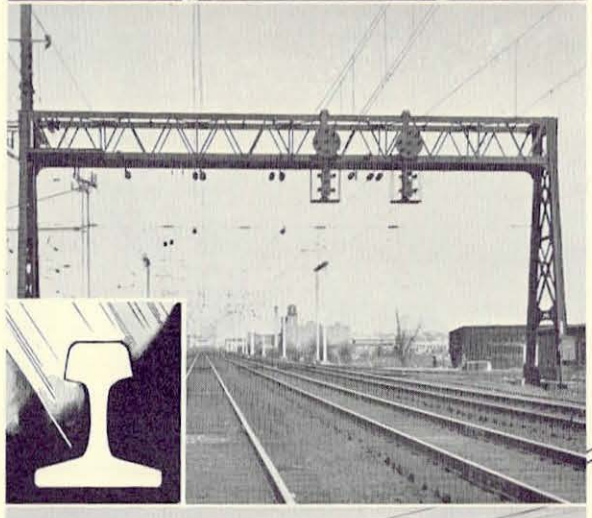
BRIDGEPORT BRASS COMPANY

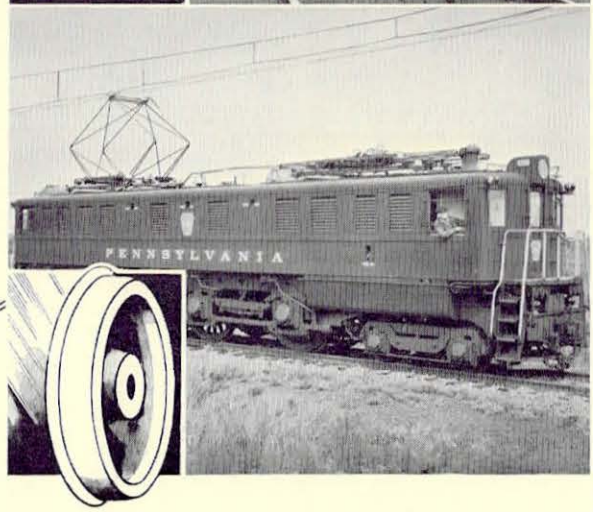
BRIDGEPORT, CONNECTICUT

CARNEGIE

the P•R•R• ELE







CARN

SUBSIDIARY OF

PRODUCTS *used in* CTRIFICATION••

CB SECTIONS for stations, catenary structures and poles to support the power transmission system.

Rails, 130 lb. section and heavier, including some of the P.R.R. 152 lb. section, the latter the heaviest now in use on steam railroads, copper steel tie plates, rail joints, spikes and bolts for the track.

Chrome nickel steel axles for electric locomotives.

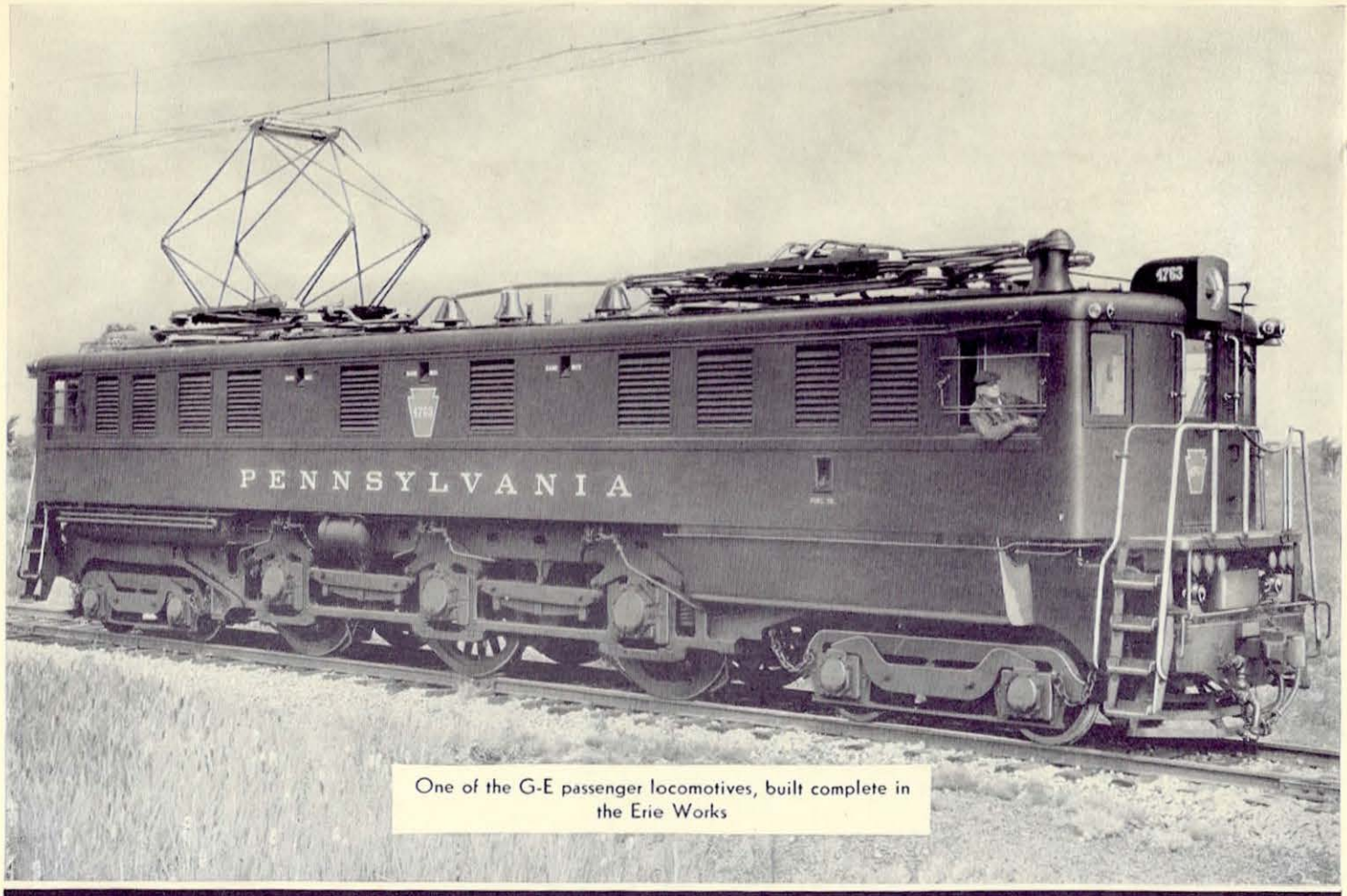
Wrought steel tender truck wheels for economy of locomotive operation and maintenance.

Carnegie's contribution to this vast engineering project.

US STEEL

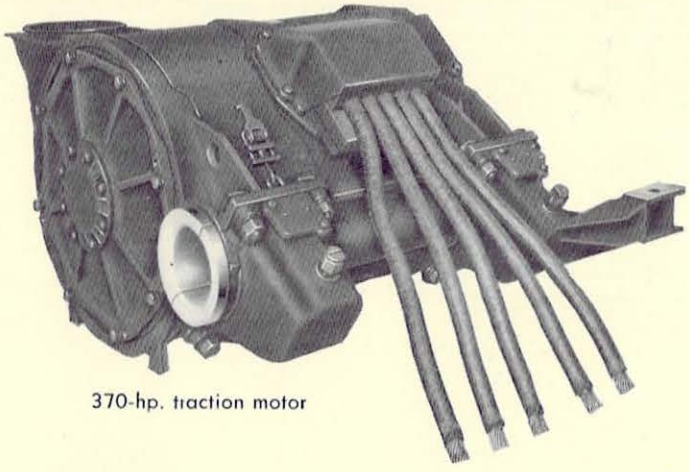
EGIE STEEL COMPANY

UNITED STATES STEEL CORPORATION • PITTSBURGH, PA•

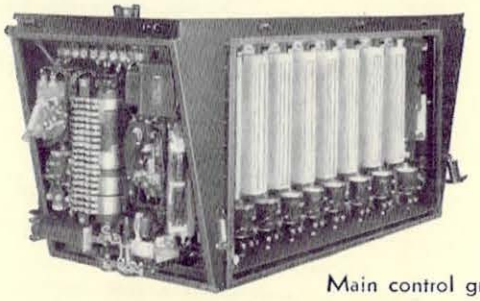


One of the G-E passenger locomotives, built complete in the Erie Works

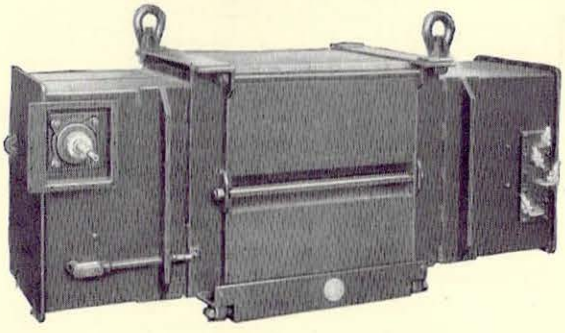
THE PENNSYLVANIA



370-hp. traction motor



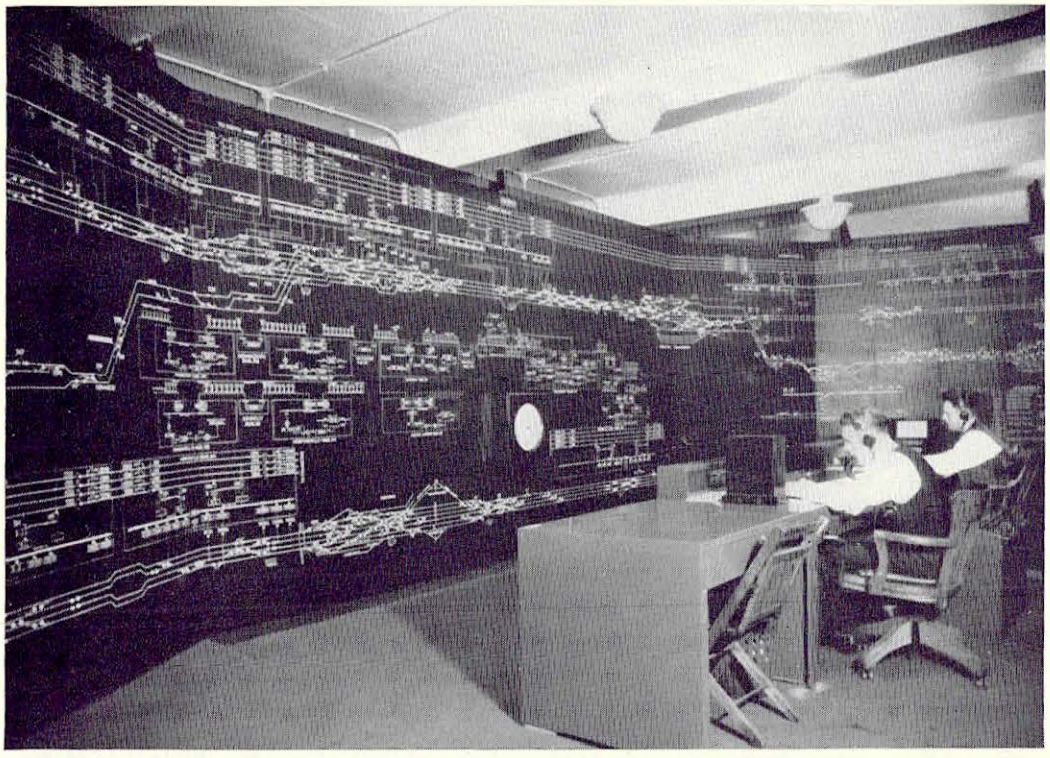
Main control group



Air-blast railway transformer

Some of the G-E equipment furnished for multiple-unit cars

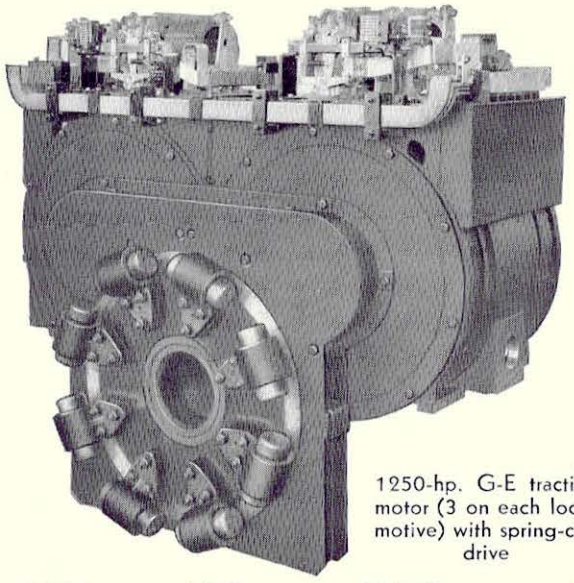
GENERAL



Power dispatcher's switchboard at Jersey City, for indicating the open or closed position of circuit breakers on the New York end of the system

MOVES FORWARD

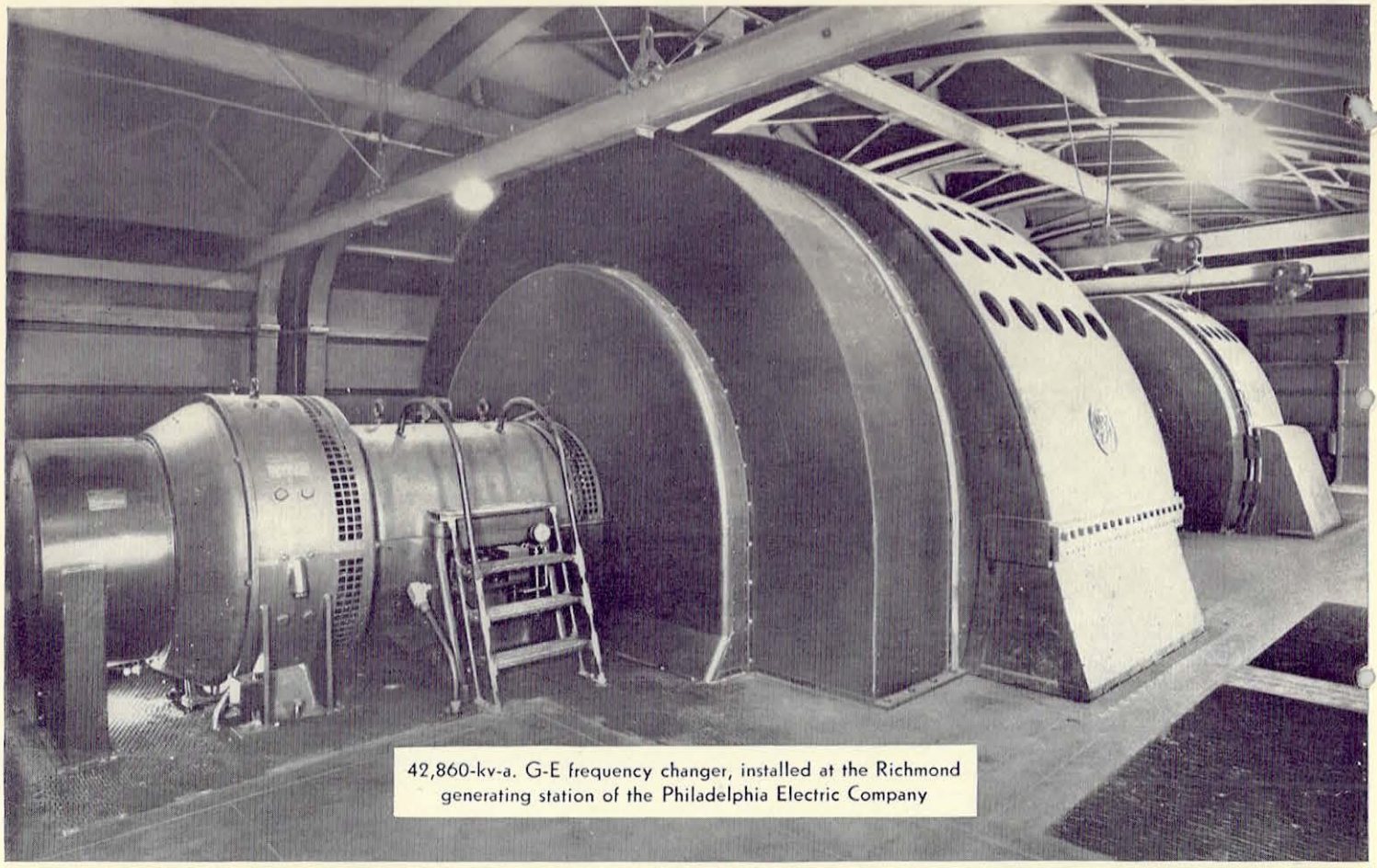
UNDER ELECTRIC POWER



1250-hp. G-E traction motor (3 on each locomotive) with spring-cup drive

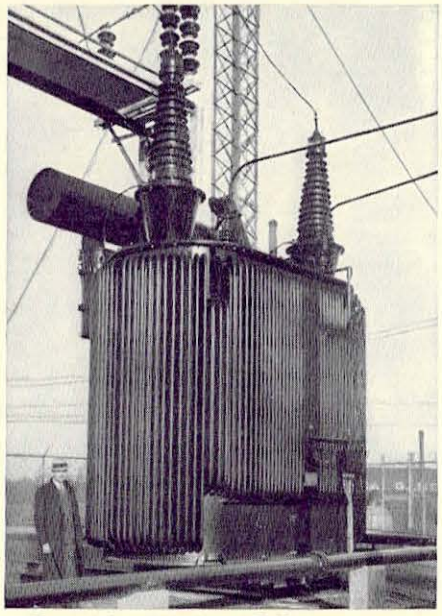
To achieve certain definite economies in operation, the Pennsylvania Railroad is wisely proceeding with a comprehensive program of electrification. This will result in faster schedules and other improvements in the service, and also will make possible a better development of the territory served. The company's courageous plan, leading to the inauguration of electric operation at this time, shows vision as to the needs of the future. General Electric is glad to have coöperated.

ELECTRIC

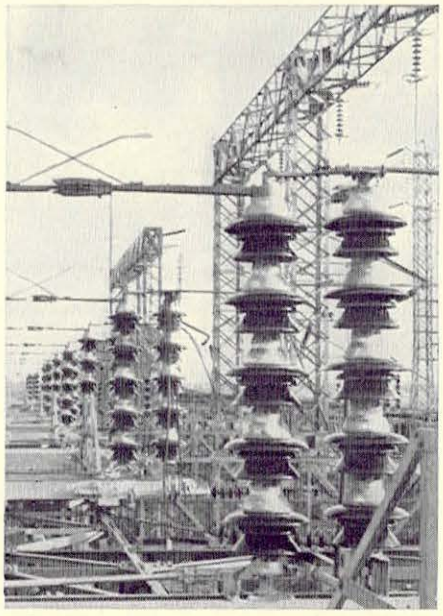


42,860-kv-a. G-E frequency changer, installed at the Richmond generating station of the Philadelphia Electric Company

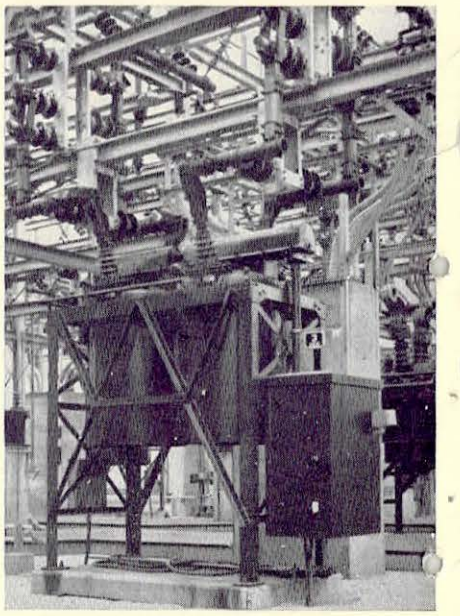
and G-E ENGINEERING



One of the 4500-kv-a. G-E power transformers that step down the transmission voltage for the 11,000-volt trolley

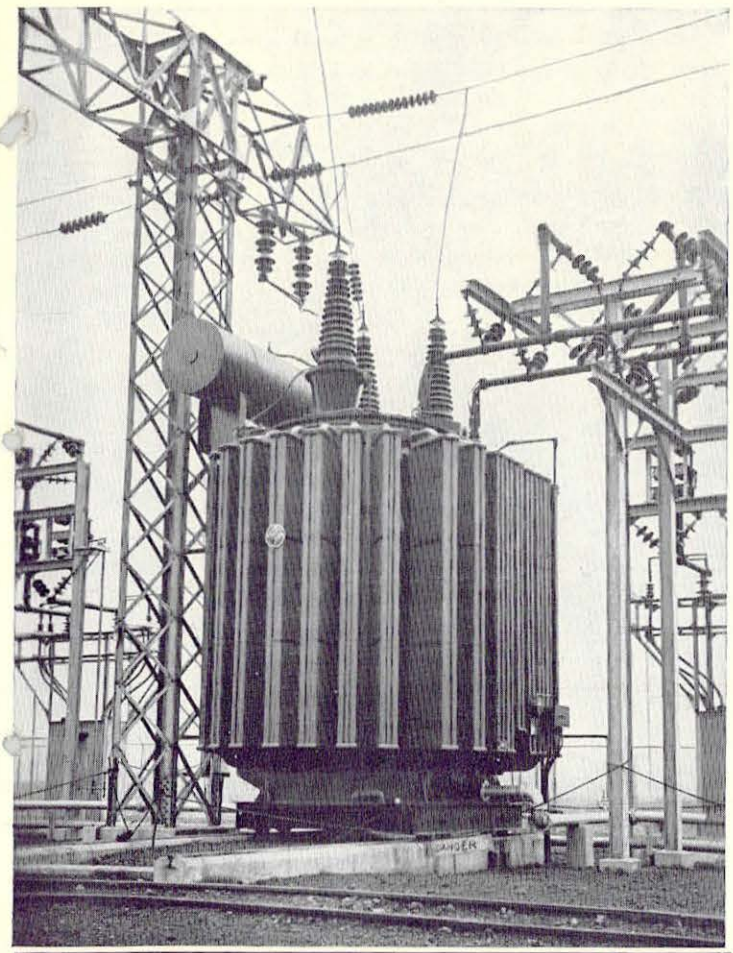


Battery of G-E motor-operated, 132-kv., horn-gap switches

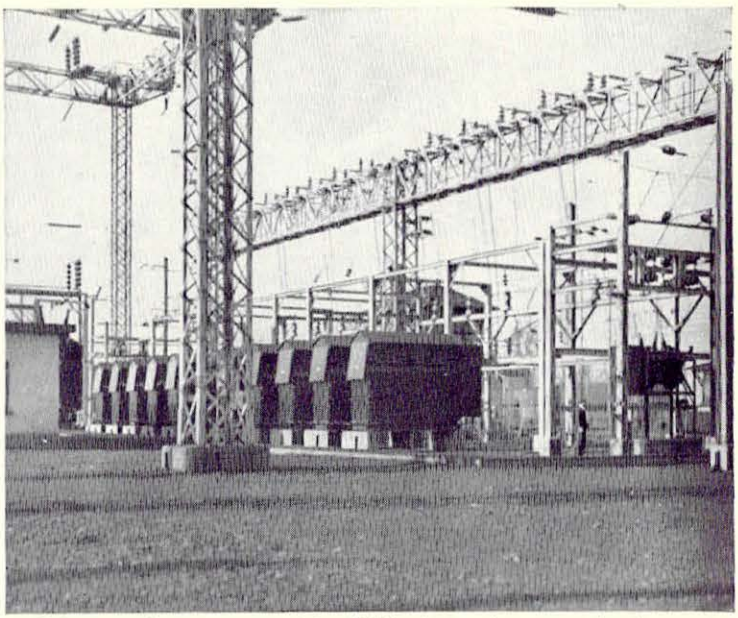


4000-amp. G-E oil circuit breaker, 2,500,000-kv-a. interrupting rating

GENERAL



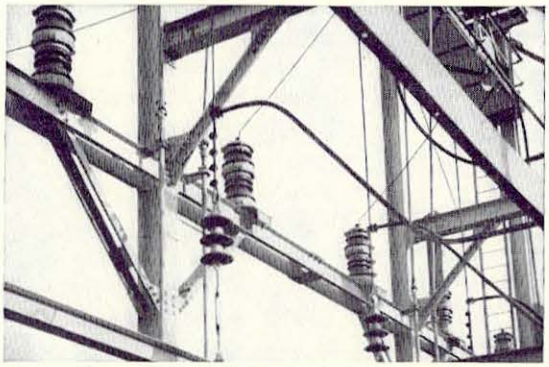
One of the 20,000-kv-a. G-E power transformers that step up the voltage to 132-kv. for transmission to substations



Substation showing some of the G-E high-speed air circuit breakers in trolley circuits. Interrupting capacity, 50,000 amperes, operating in .04 of a second or less

SERVES

ANOTHER EPOCH-MAKING PROJECT



Some of the G-E Thyrite lightning arresters

BESIDES its magnitude, the Pennsylvania electrification is notable for many innovations. Among these are new features of locomotive design and construction; new methods of control and protection of power supply and distribution to assure reliability of service. These indicate some of the problems which G-E engineers helped to solve. General Electric has furnished for this project a great variety of equipment, including complete motive-power units. General Electric Company, Schenectady, N. Y.

95-988

ELECTRIC

TIGERWELD PLUG TYPE POWER BONDS

WITHSTAND EXCESSIVE VIBRATORY STRESSES

The Tigerweld DS-4 Power Bond is an outstanding example of engineering leadership. In this bond are successfully combined the proved advantages of a copper conductor and a steel conductor, producing a construction of great mechanical strength having sufficient capacity to carry the return current. Users tell us that this bond sets a new standard in bond performance—providing a construction that is capable of withstanding excessive vibratory stresses. Specify Tigerweld DS-4 Bonds for multiple track A. C. Systems.

FOR MULTIPLE TRACK A. C. SYSTEMS

TYPE DS-4

This bond is designed to make a drive fit into 3/8 inch holes in the rail web. The terminals are the same as those of our signal bonds, which are widely used throughout the country. The two strands are flash butt welded to the terminals simultaneously. This weld is stronger than the strand.

1831 MORE THAN 100 YEARS OF PROGRESS IN WIRE MAKING 1933

AMERICAN STEEL & WIRE COMPANY

208 South La Salle Street, Chicago
94 Grove Street, Worcester

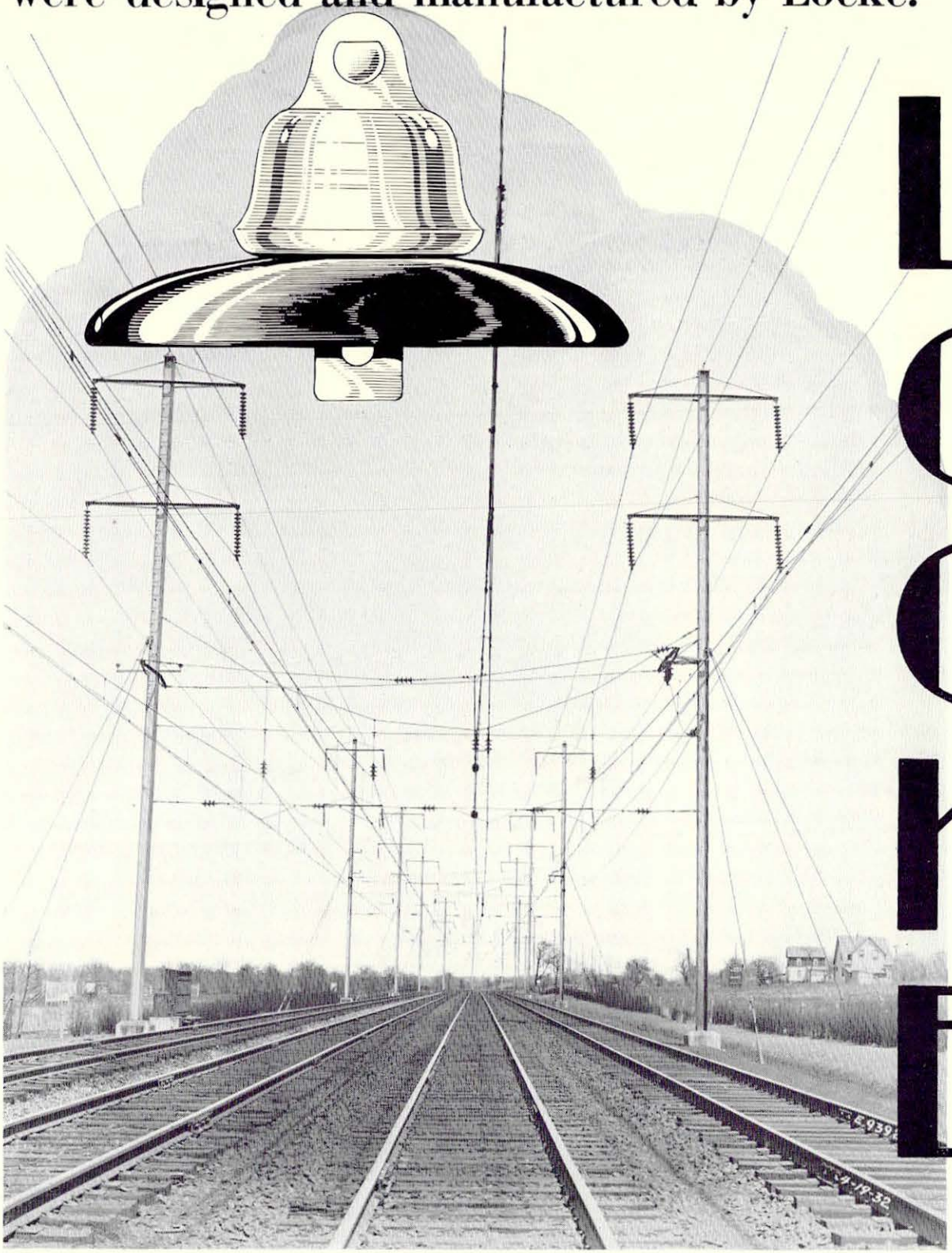
SUBSIDIARY OF UNITED STATES STEEL CORPORATION
AND ALL PRINCIPAL CITIES

Empire State Bldg., New York
First National Bank Bldg., Baltimore

Pacific Coast Distributors: Columbia Steel Company, Russ Building, San Francisco

Export Distributors: United States Steel Products Company, New York

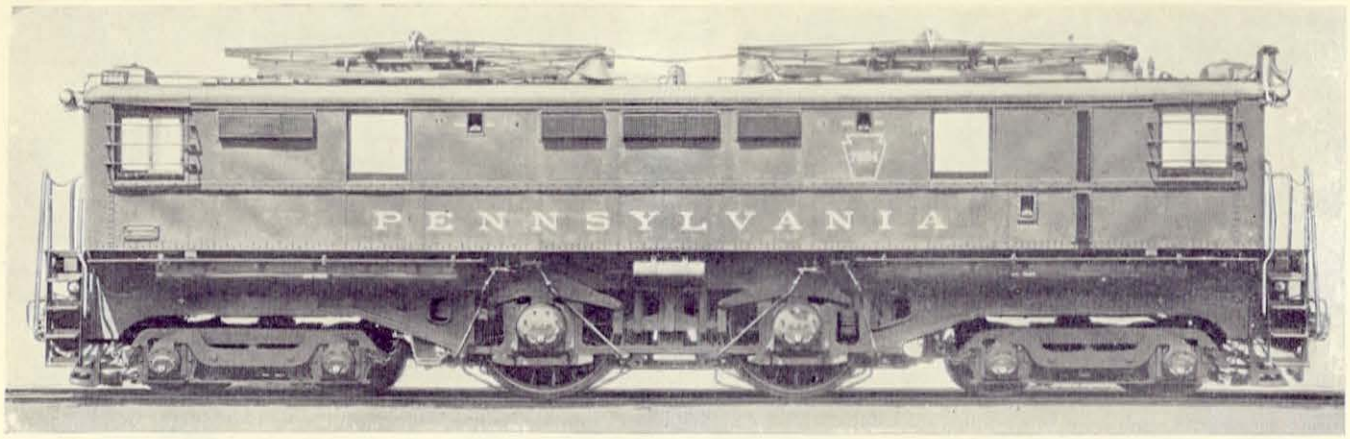
The majority of the insulators used on railroad electrifications in this country were designed and manufactured by Locke.



LOCKE

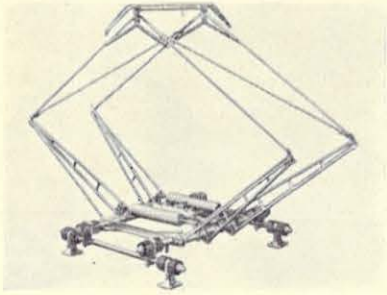
A section of the newly electrified main line of the Pennsylvania Railroad.

LOCKE INSULATOR CORPORATION · · BALTIMORE, MARYLAND

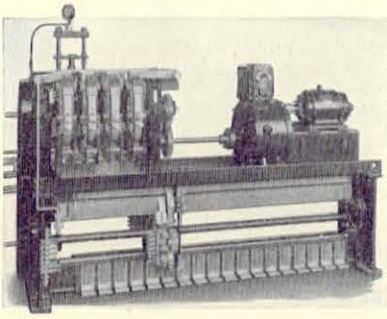


PRR—Class O1B Electric Passenger Locomotive for 11000 Volts—25 Cycles, single phase, A.C.

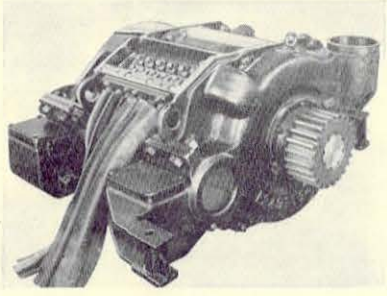
ALLIS-CHALMERS
in the field of



Pantograph Current Collector of PRR —Class O1B Electric Locomotive.



Main Controller (tapping switch) of PRR Class O1B Electric Locomotive.



225 h. p. — Single phase Commutator Railway Motor of PRR Class MP-54—Multiple Unit Car.

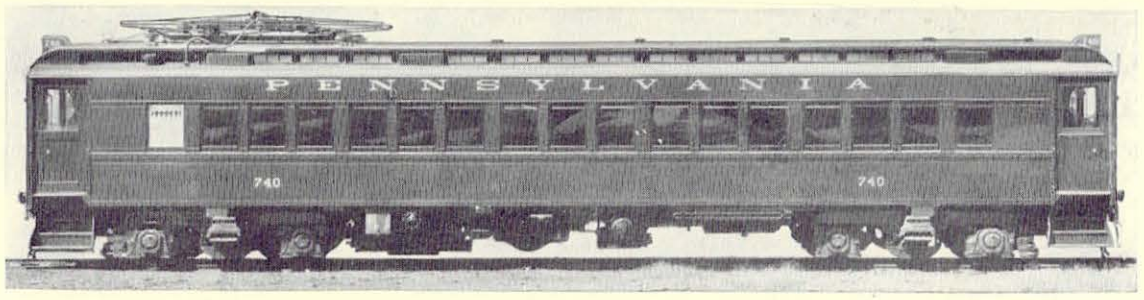
SUBSTANTIAL orders for heavy electric traction equipment have recently been completed at the several plants of the Allis-Chalmers Manufacturing Company, or are now under contract. These include orders for railway locomotive equipment, mercury arc rectifiers, large power transformers, high tension oil circuit breakers, etc.

The recent acquisition of the principal assets of the American Brown Boveri Company, Inc., together with its engineering and manufacturing personnel, has placed Allis-Chalmers in a strongly competitive position in the traction field.

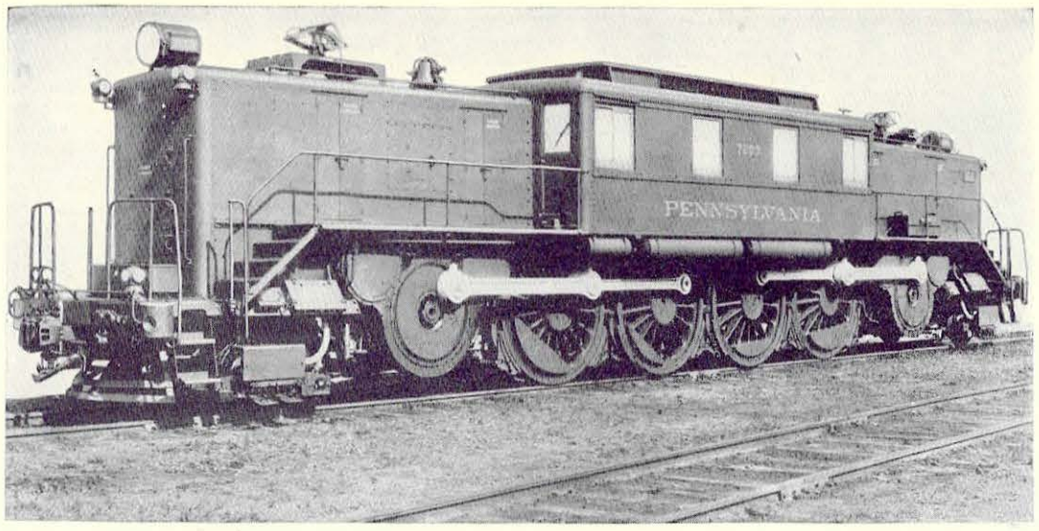
Through agreement with Brown Boveri & Co. Ltd., Switzerland, Allis-Chalmers has acquired the rights to the research, designs, patents, manufacturing and operating experience of the Swiss Company in all branches of railway electrification.

The experience of the Swiss Company, which holds a pre-eminent position in the European traction field, includes many of the major electrification projects of leading European countries, and embraces both alternating and direct current systems.

Allis-Chalmers Manufacturing Company with its established reputation and excellent manufacturing facilities in the field of heavy power, electrical and industrial machinery, backed by the experience and with the active co-operation of this outstanding European manufacturer, is able to offer unexcelled service to American railroads in their electrification problems.

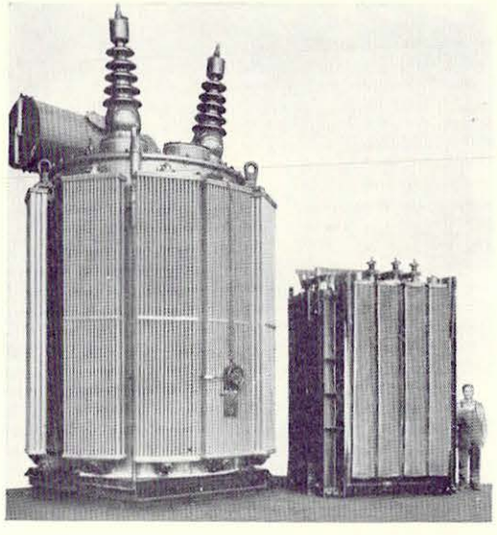


PRR Class MP-54 Multiple Unit Motor car for 11000 volts—25 cycles, single phase, A.C.



200 Tons—PRR Class L5 pdb Electric Passenger Locomotive for 650 volts, D.C.

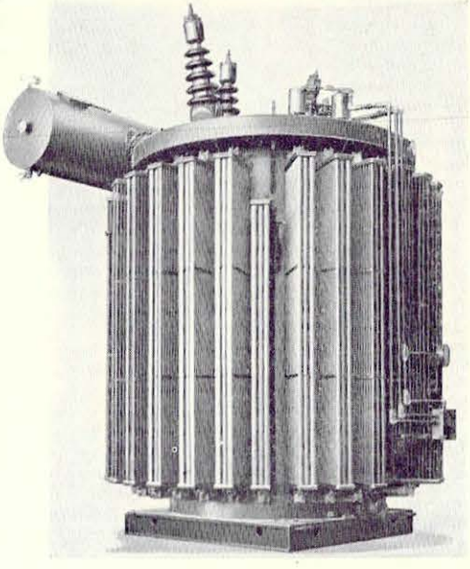
Heavy Electric Traction

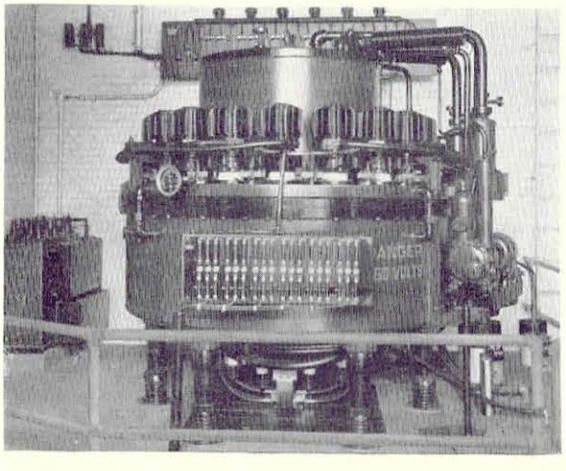


Left — 4,500 Kva., 25 cycles, single phase, Power Transformer, 132,000 to 12,000 Volts.

Right — 20,000 Kva., 25 cycles, single phase, Power Transformer, 132,000 to 12,000 volts.

Below left—One of nine 3000 kw. 650 volt Automatic Mercury Arc Rectifier units installed on the system of the Long Island Railroad, a subsidiary of the PRR.



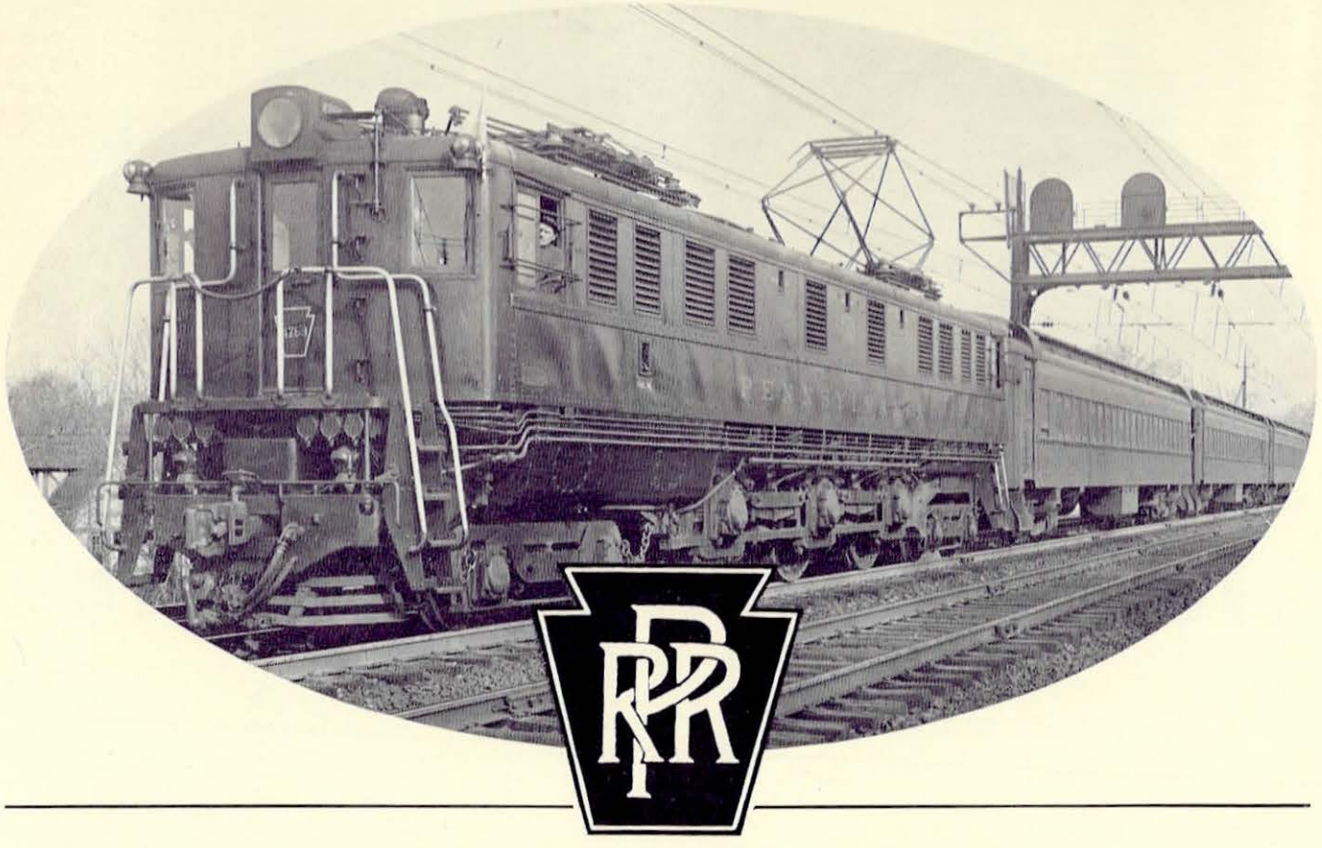


ALLIS-CHALMERS PRODUCTS

- Electrical Machinery
  - Motors - Generators
  - Switchgear - Transformers
  - Mercury Arc Power Rectifiers
  - Railway Electrification Equipment
  - Generator Voltage Regulators
- Steam Turbines
- Steam, Gas and Oil Engines
- Condensers
- Hydraulic Turbines
- Pumping Engines
- Centrifugal Pumps
- Compressors and Blowers
- Mining and Metallurgical Machinery
- Crushing and Grinding Machinery
- Screening and Washing Machinery
- Cement Making Machinery
- Flour and Cereal Mill Machinery
- Saw Mill Machinery
- Electric Mine Hoists
- Texrope Drives - Transmission Machinery
- Timber Preserving Machinery
- Coal Distillation Machinery
- Forgings and Plate Work
- Tunnel Shovels
- Farm, Industrial and Track-type Tractors
- Tillage and Harvesting Machinery
- Road Machinery

ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee



THE PENNSYLVANIA USES EXIDES

THE completion of the Pennsylvania Railroad's electrification project between New York and Philadelphia marks a decided step forward in modern transportation, and again Exide Batteries play their important part.

Sixty-five electric locomotives will be equipped with Exide-Ironclad Batteries which supply power for the locomotive control equipment, energize the cab signal circuit, and furnish emergency lighting during a power interruption.

In 12 substations the distribution of high-voltage propulsion current is handled by oil circuit breakers which are opened and closed by the power of dependable Exides.

All telephone and communication lines, including the printer circuits and the power director's selector ringing circuits, are energized by Exide Batteries located in New York and Jersey City.

Exide has always maintained the highest quality in its batteries. The result is that for every railway use there is a dependable Exide Battery that will do its job every day throughout a long, active life.

Left — Battery Plant in Penna. Station, New York City. 124 cells Exide Chloride for Telegraph Loops and Selector Ringing Telephone Circuits. Top shelf, right, 32 cells which furnish line current for metallic telegraph and printer channels. Middle shelf, right, 11 cells for clock operation. Lower shelf, right, 11 cell, 480 amp. hr. battery for relay control circuits and transmission battery for Toll Test Board.

Exide
BATTERIES
for
EVERY RAILWAY USE

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia
THE WORLD'S LARGEST MANUFACTURERS OF STORAGE BATTERIES FOR EVERY PURPOSE
Exide Batteries of Canada, Limited, Toronto

EQUIPMENT

for the Pennsylvania Electrification

...SUPPLIES

for every electrical job

A great railroad takes an important step forward—and again Graybar electrical equipment takes part in a major electrical development... Western Electric Telephone Cable, Telegraph and Telephone Equipment, Bermico Fibre Conduit, Train Dispatching Equipment, Wire and Miscellaneous Electrical Supplies—these are the products from Graybar that you'll find on the job in the Pennsylvania electrification... Which is one example of Graybar's supplies service for railroads... Marshalled in 76 strategically located warehouses from coast to coast, Graybar's stocks of 60,000 electrical items are readily available to railroad users everywhere. Equally available is Graybar's long experience in meeting specialized railroad needs.

GraybaR

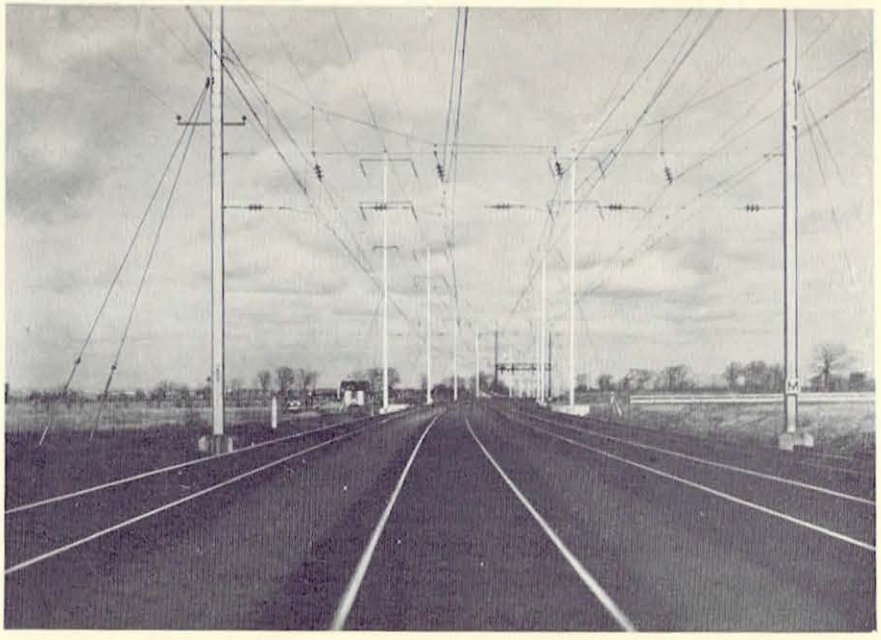
OFFICES IN 75 PRINCIPAL CITIES. EXECUTIVE OFFICES: GRAYBAR BUILDING, N. Y.

BRILLIANCY — PERMANENCY
WATERPROOFNESS

DIXON'S

ALUMINUM PAINT

brought these necessities to the catenary electrification system of the Pennsylvania Railroad.



DIXON'S Aluminum Paint combines the qualities of waterproofness, beauty and long life—imperative factors in the modern scheme of property maintenance.

Hundreds of bridges, water tanks, gas holders, transformers, tank cars and storage equipment are finished with Dixon's. The specialized purpose of Dixon's Aluminum Paint as exemplified on the tremendous electrification project of the P. R. R. is ***to protect and beautify exposed steel . .***

PAINT SALES DIVISION

JOSEPH DIXON CRUCIBLE COMPANY

Jersey City, N. J.

FOR SAFE, RELIABLE AND PERMANENT SERVICE

KERITE

IN THREE-QUARTERS OF A CENTURY OF CONTINUOUS PRODUCTION HAS ESTABLISHED A RECORD OF PERFORMANCE THAT IS UNEQUALED IN THE HISTORY OF INSULATED WIRES AND CABLES

KERITE SIGNAL WIRES AND CABLES WERE USED EXTENSIVELY BY THE PENNSYLVANIA RAILROAD ON THE ELECTRIFICATION FROM NEW YORK TO WASHINGTON

THE KERITE INSULATED WIRE & CABLE COMPANY INC

NEW YORK CHICAGO SAN FRANCISCO

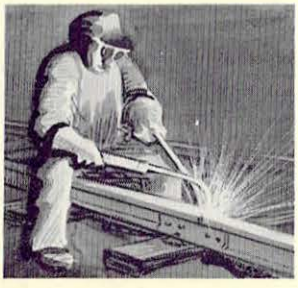
Photo, courtesy of the Pennsylvania R. R.

A splendid work of modernization completed. One of the most important stretches of road in the country electrified — without interruption to service. A fine piece of railroad improvement, ably conceived and executed by a progressive management and organization.

AIRCO is proud to be included among those whose products were used in this project. AIRCO is pleased to have the name of the Pennsylvania on the long list of railroads it is serving.

AIRCO'S Railroad Department is made up of experienced men. It has assisted many railroads on such work as car scrapping, locomotive repairs, heat treating and reforming of rail ends, rail bonding, pipe welding, steel construction and maintenance and the hundred and one other operations on which oxyacetylene cutting and welding are employed in railroading today.

The cooperation of this Department is offered to railroad customers on any problem or work involving oxyacetylene cutting or welding.



AIR REDUCTION SALES CO.

General Offices: 60 East 42nd St., New York

Airco Oxygen—Airco Acetylene—Supplies—National Carbide Airco—Davis—Bournonville Welding and Cutting Apparatus
Oxygen and Acetylene Plants conveniently located thruout the country and in all cities having District Offices.

DISTRICT OFFICES

Baltimore	Charlotte	Jersey City	New Orleans	San Francisco
Bettendorf, Ia.	Chicago	Kansas City, Mo.	Oklahoma City	Seattle
Birmingham	Cincinnati	Los Angeles	Philadelphia	Shreveport, La.
Boston	Cleveland	Louisville	Pittsburgh	St. Louis
Buffalo	Dayton	Milwaukee	Portland, Ore.	Wheeling
	Detroit	Minneapolis	Richmond	

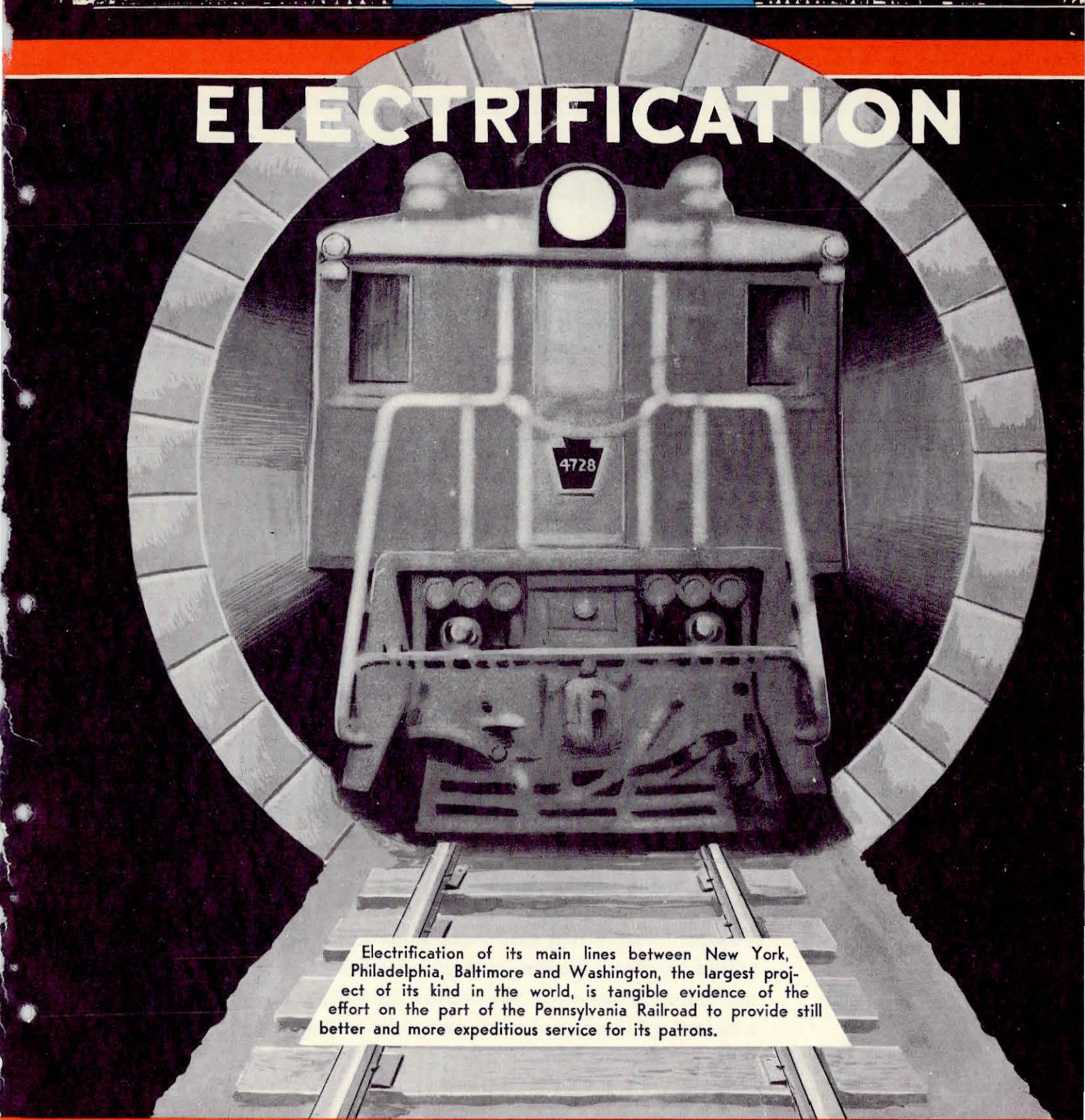
Represented in Texas by Magnolia Airco Gas Products Co., Houston, Beaumont, Wichita Falls, El Paso, Fort Worth and San Antonio. In Canada by Railway & Engineering Specialties, Ltd., Montreal, Que.

OXYACETYLENE CUTTING and WELDING EQUIPMENT and SUPPLIES

NEW YORK

PHILADELPHIA

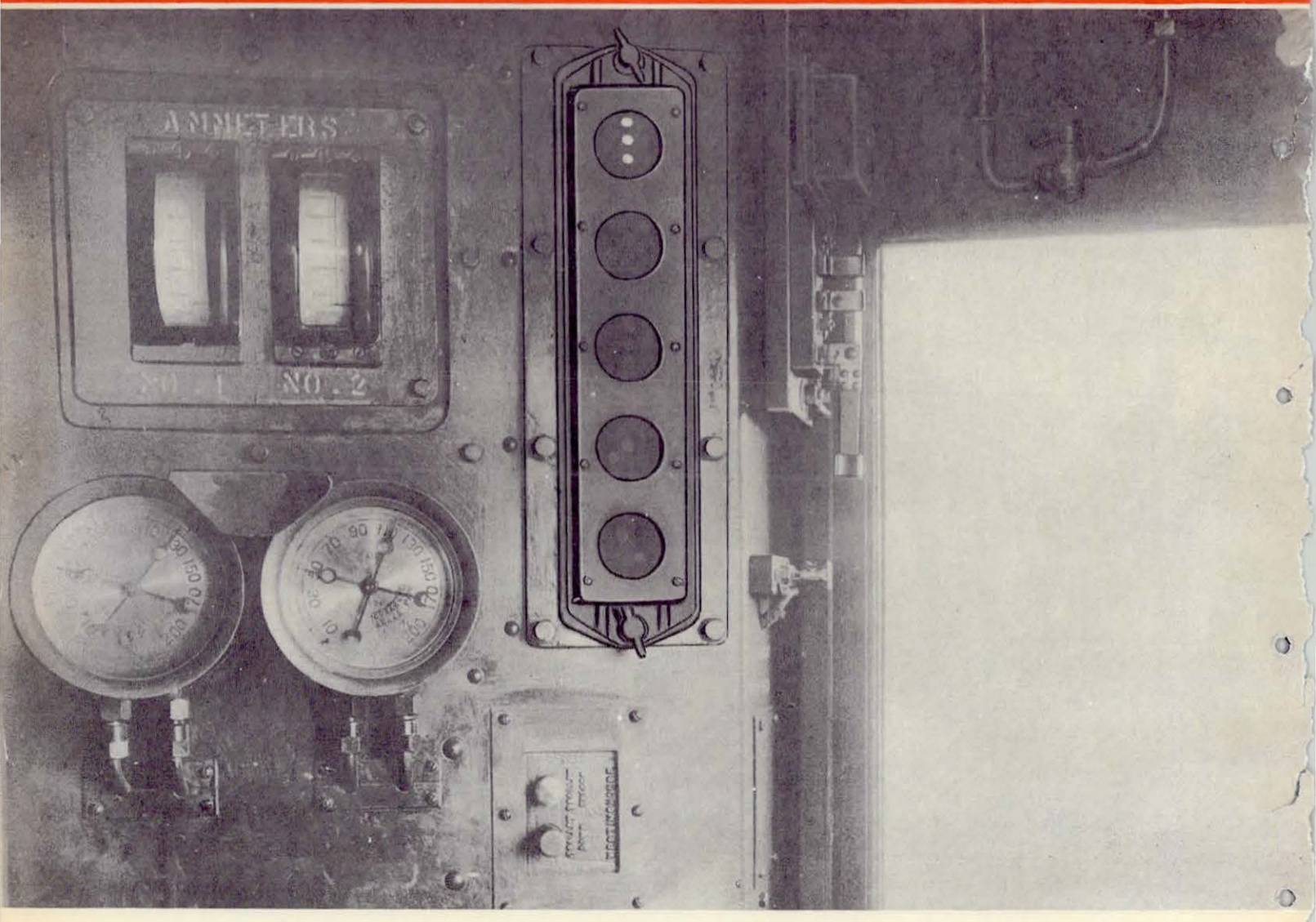
ELECTRIFICATION



Electrification of its main lines between New York, Philadelphia, Baltimore and Washington, the largest project of its kind in the world, is tangible evidence of the effort on the part of the Pennsylvania Railroad to provide still better and more expeditious service for its patrons.

1881 Union Switch & Signal Co. 1933

SWISSVALE, PA.



"The Signal in the Cab" gives the enginemen a continuous indication of the conditions ahead and instantly shows any change in those conditions regardless of the location of the train with respect to wayside signals.

SIGNALING FOR GREATER SPEED WITH SAFETY

"Union" Continuous Cab Signals are safeguarding the maintenance of schedules in the electrified territory, which is subject to the severe fogs frequently encountered along the Atlantic Seaboard. "Union" Position-Light Wayside Signals also play an important part in signaling for greater speed with safety.

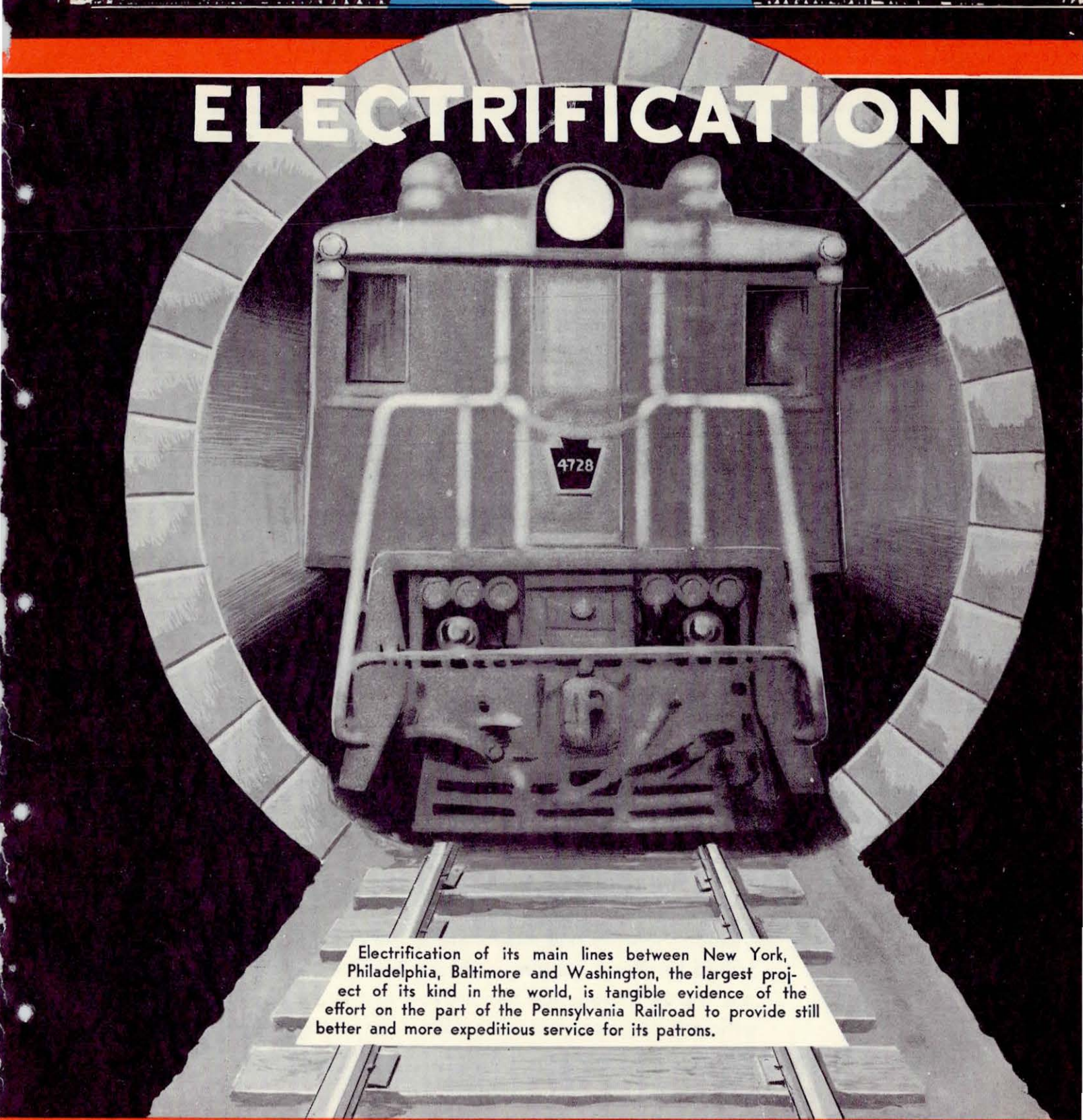
1881 **Union Switch & Signal Co.** 1933

SWISSVALE, PA.

NEW YORK

PHILADELPHIA

ELECTRIFICATION



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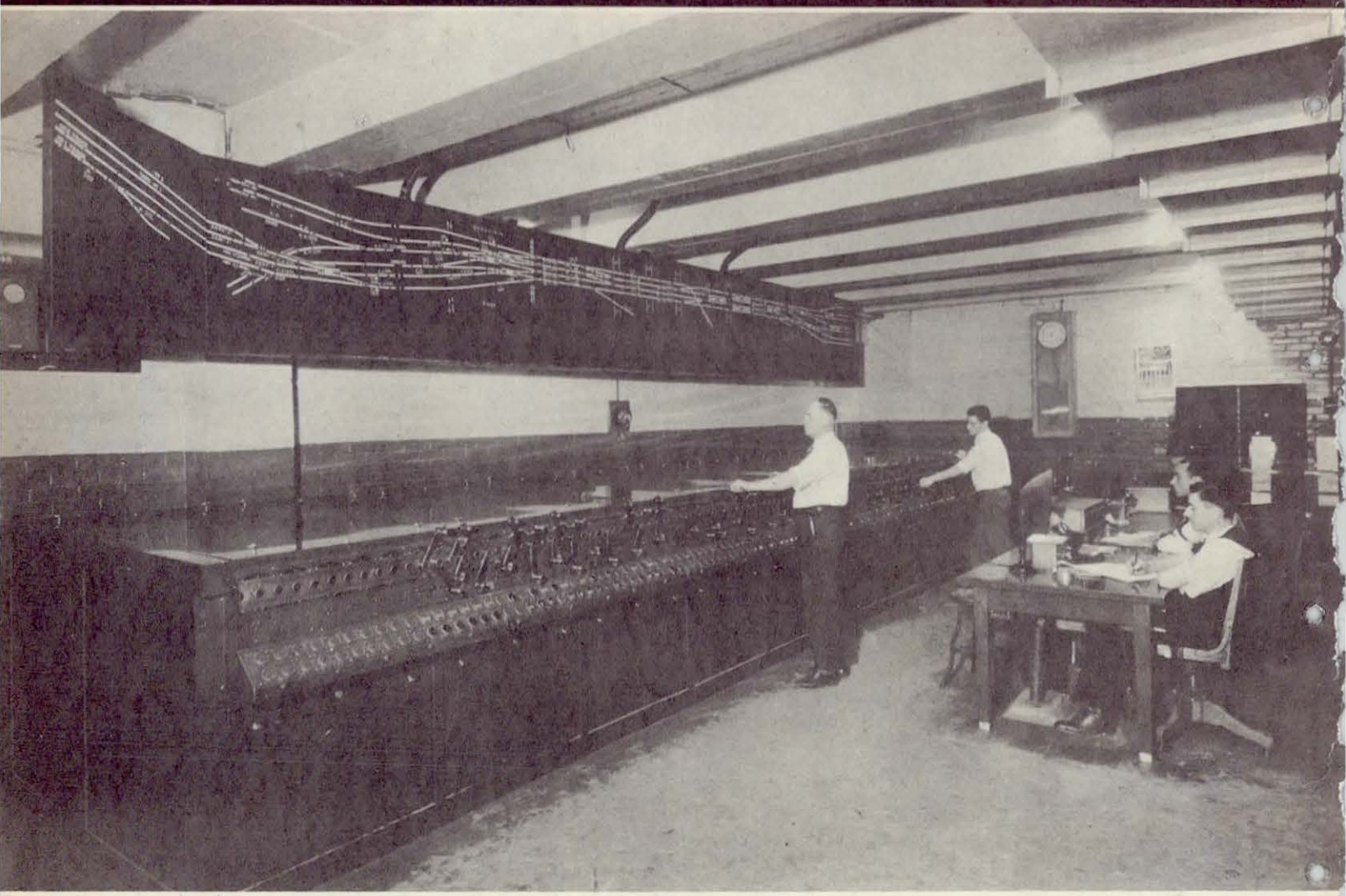


"Union" interlockings are important cogs in the signal system.

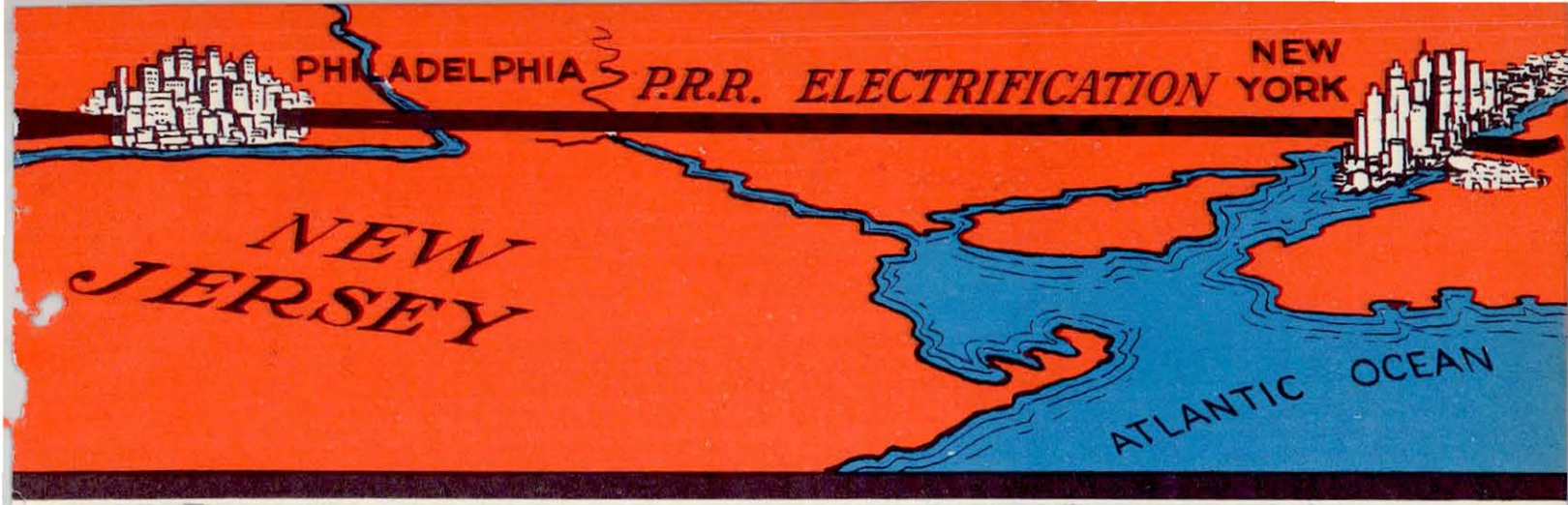
A STEADY TRAFFIC FLOW ASSURED

"Union" Interlocking Plants are in service throughout the electrified territory, assuring a steady traffic flow through terminals and yards. Experience has proved that these Interlockings give efficient and economical service over a long period.

1881 - 1933

DISTRICT OFFICES

NEW YORK MONTREAL CHICAGO ST. LOUIS SAN FRANCISCO



. . . . . AT A LOWER COST PER TON MILE

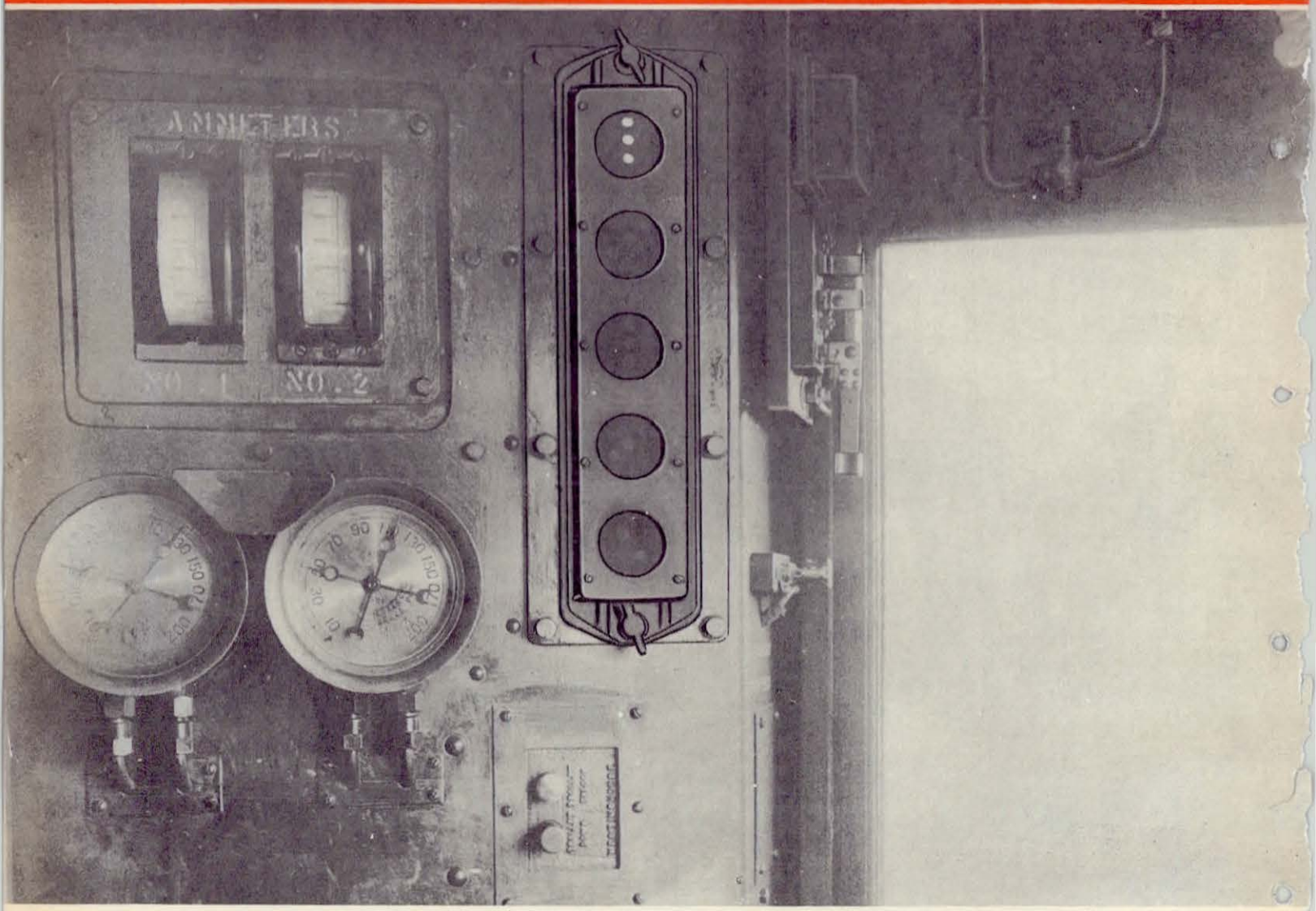
"Union" Signals—wayside and cab—help materially in securing a lower cost per ton mile by expediting traffic with increased safety. They reduce transportation costs by eliminating expensive delays and assist in giving superior transportation service.

The cab signal on the locomotive and the position light signal along the wayside provide for maximum speed with safety.

1881 - 1933

1881 **Union Switch & Signal Co.** 1933

SWISSVALE, PA.



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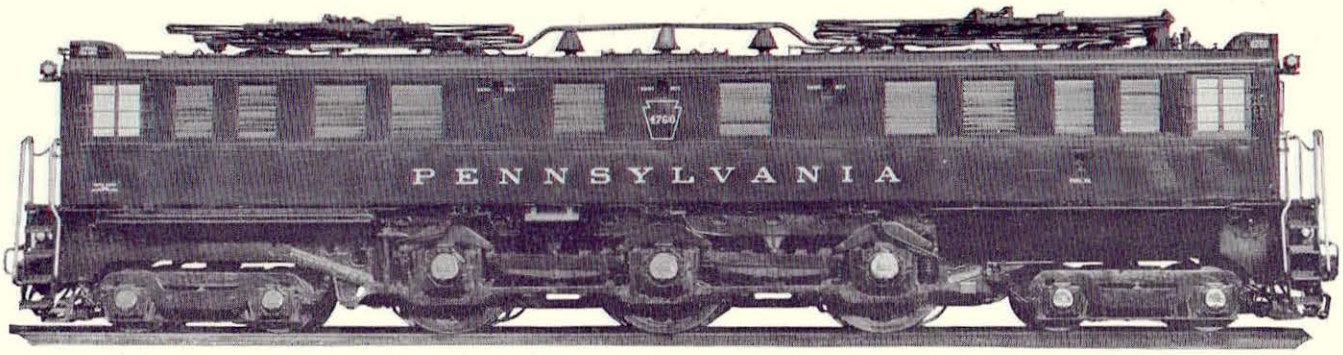


ONE OF THE NEW PASSENGER LOCOMOTIVES CLASS P-5-A

PENNSYLVANIA ELECTRICS

EQUIPPED WITH

LOCOMOTIVE BEDS

ONE PIECE CAST STEEL BED FOR CLASS P-5-A LOCOMOTIVE

Co-operating with the Railroad on Design:

Locomotive beds were produced at the Eddystone plant for all of the new electric passenger and freight locomotives.

Integral Cast Steel Construction combines in a single unit, frames, crossties, reservoirs (air, oil and water), and many other parts. Eliminates hundreds of bolts and rivets. Provides the same advantages as obtained on steam locomotives.

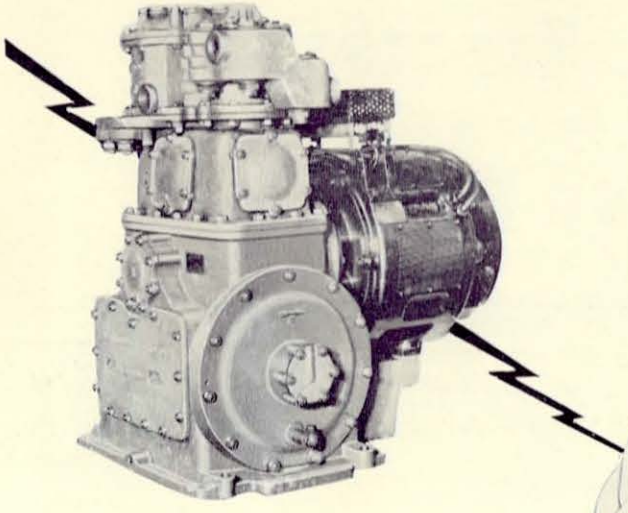
MAXIMUM STRENGTH **ELIMINATION OF MAINTENANCE**

GENERAL STEEL CASTINGS CORPORATION

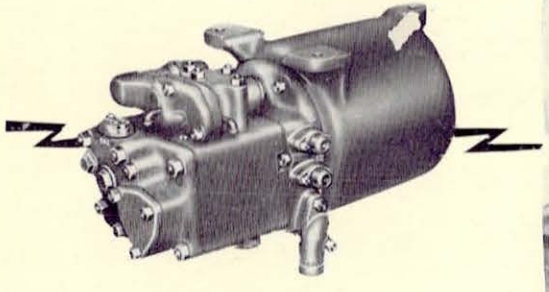
COMMONWEALTH PRODUCTS

EDDYSTONE, PA. GRANITE CITY, ILL.

AIR BRAKES AND

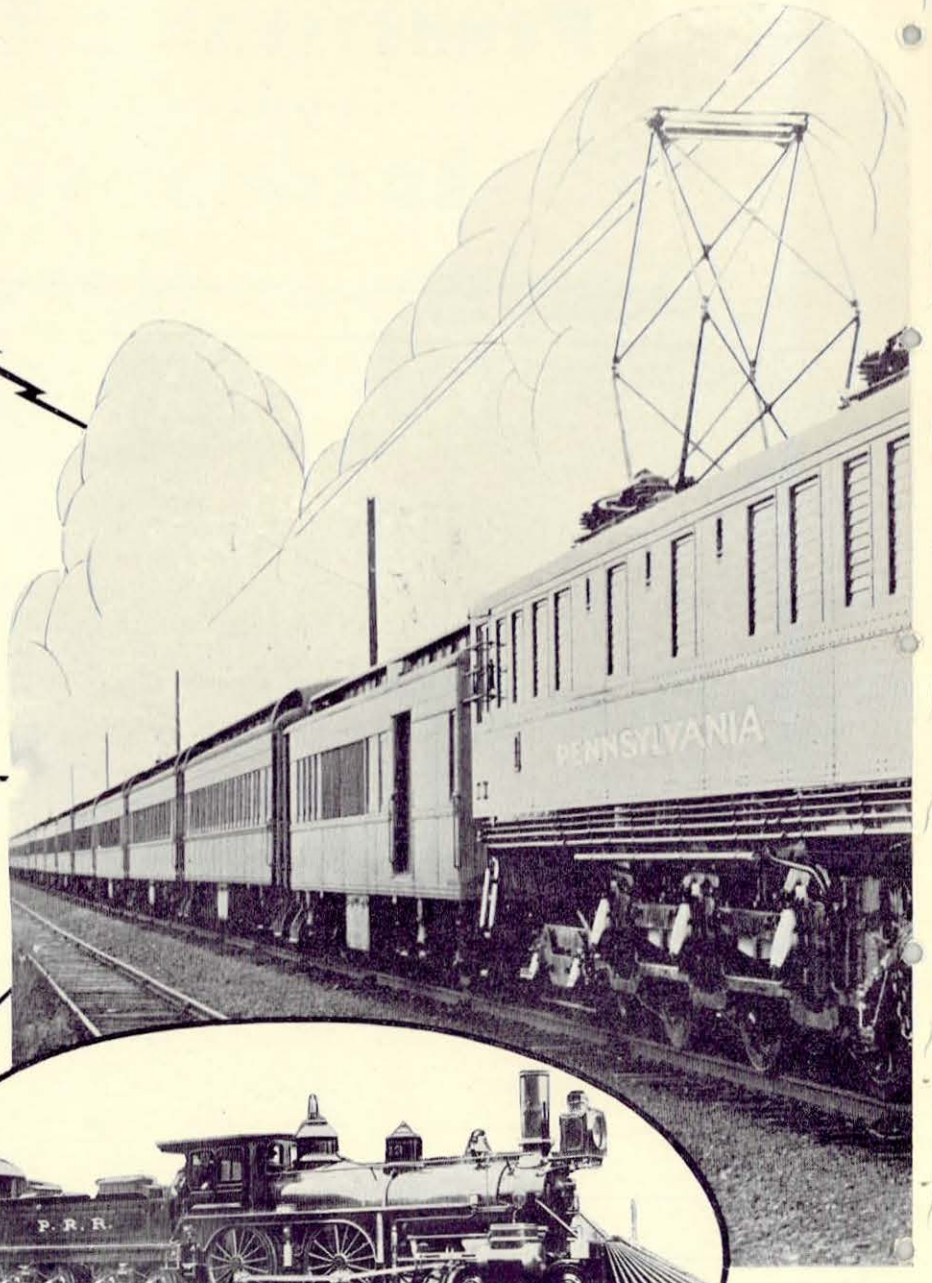


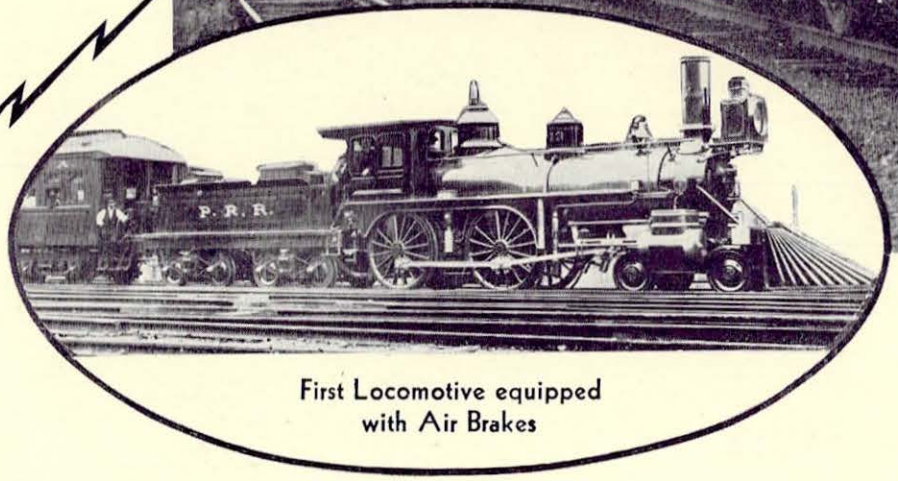
Air Compressor



Distributing Valve

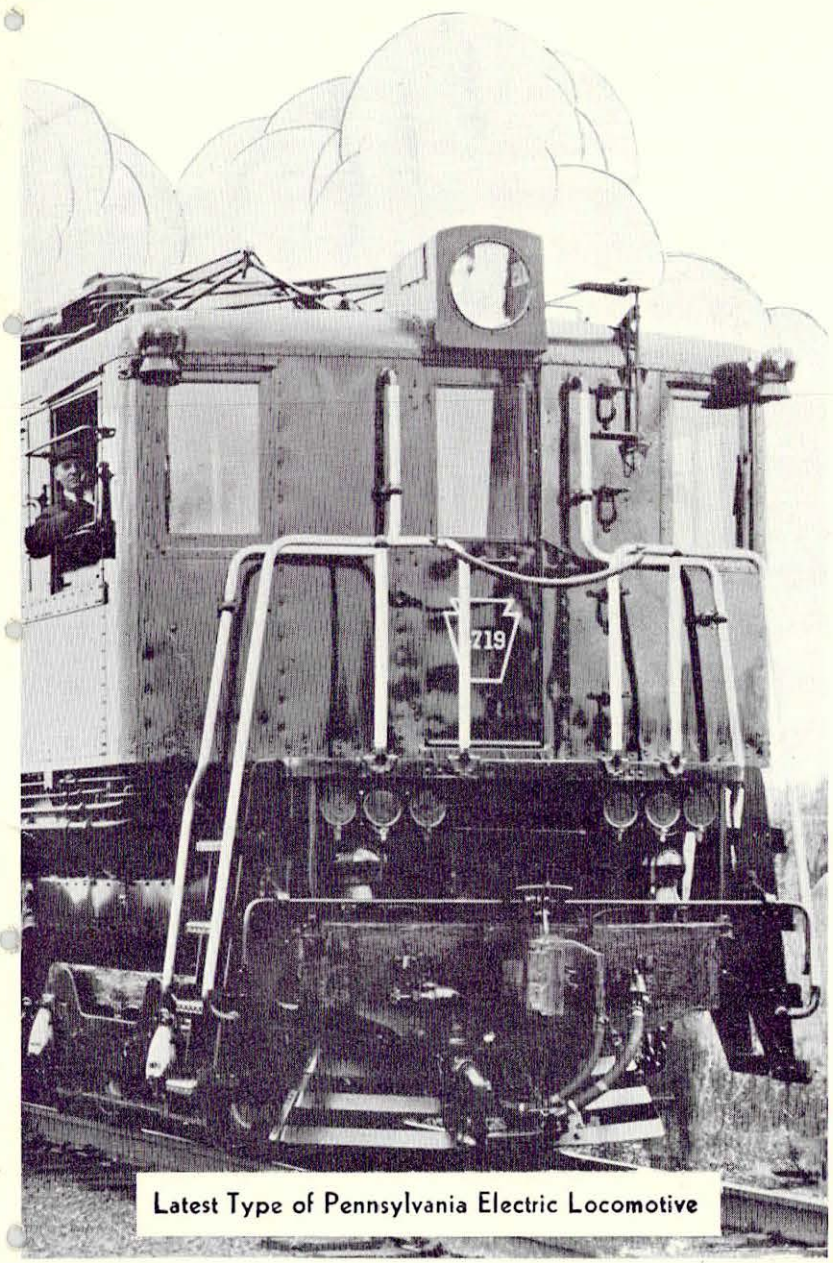
Brake Valve





First Locomotive equipped with Air Brakes

ELECTRIFICATION PROGRESS



Latest Type of Pennsylvania Electric Locomotive

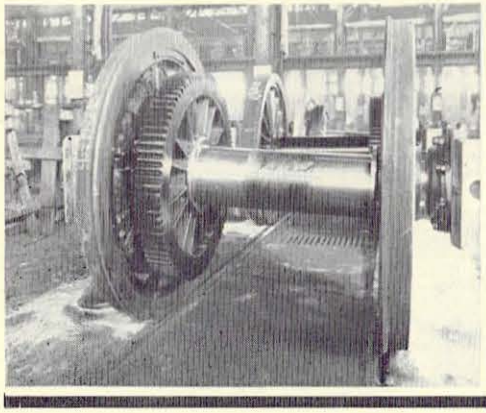
A Pennsylvania locomotive was the first to be equipped with Westinghouse Air Brakes. This significant event—in 1869—marked the beginning of real railway progress . . . In every new form and improvement of transportation throughout these 64 years the Air Brake has played a prominent part . . . During the time that steam was the only motive power major advancements in cars and locomotives were promoted by suitable types of brake equipment . . . When electricity came into use, here also was the Air Brake—modified and adapted to suit the special conditions of motor car and locomotive operation . . . And now comes this great electrification project with its powerful locomotives for main line operation between great cities, and multiple unit trains for suburban service. For this motive power and rolling stock the most modern Air Brakes are provided.

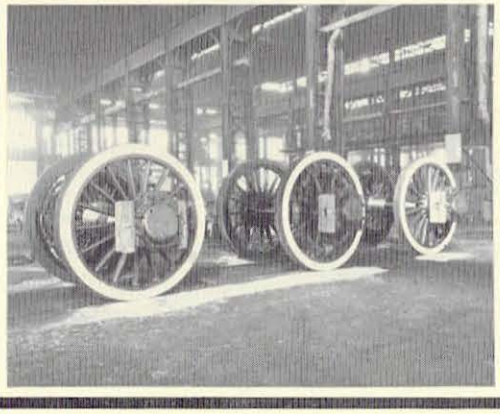
We congratulate the Pennsylvania Railroad for their progress in electrification, and are glad to have had a part in this achievement.

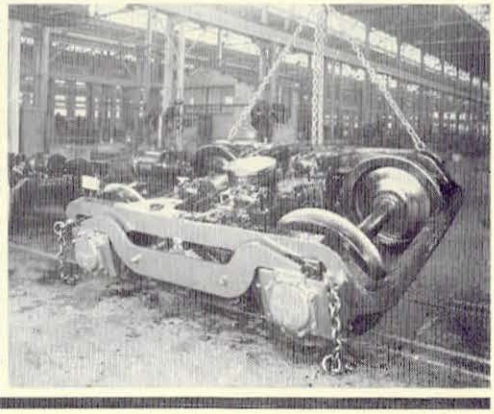
WESTINGHOUSE AIR BRAKE CO.

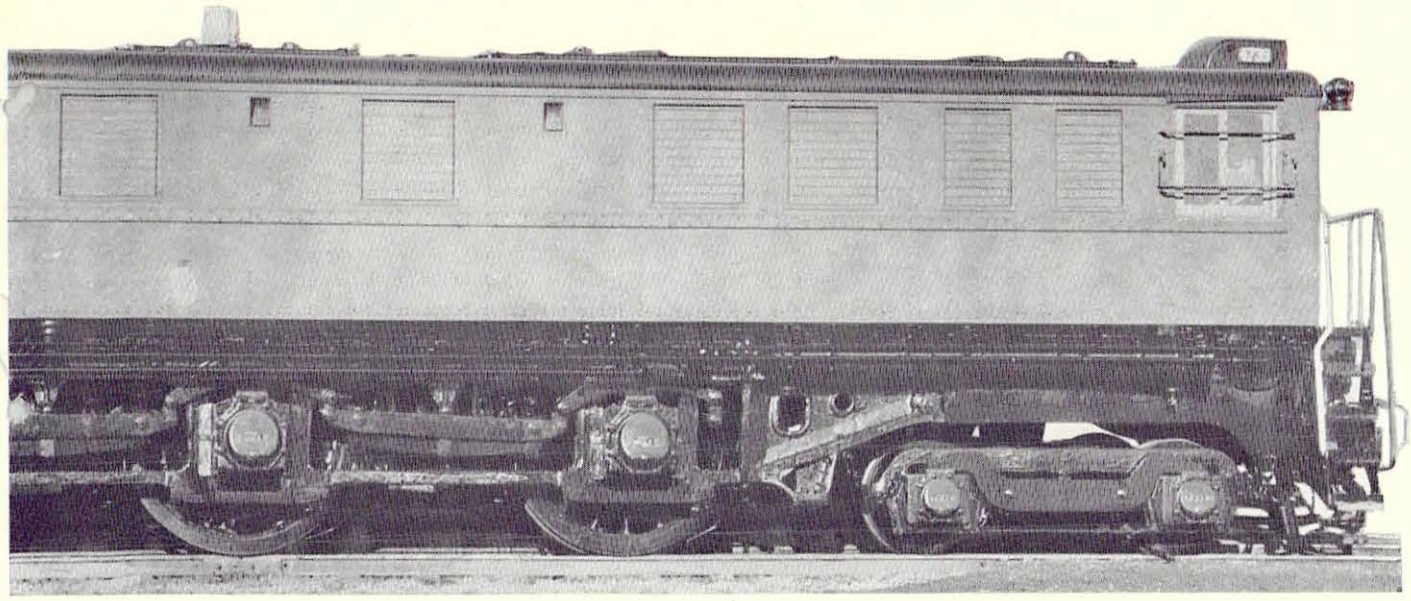
General Office and Works « » WILMERDING, PA.

CON









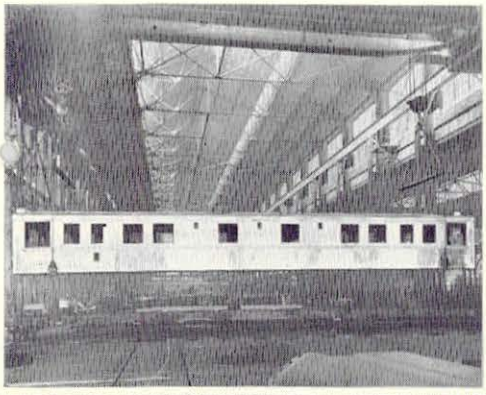
GRATULATIONS-

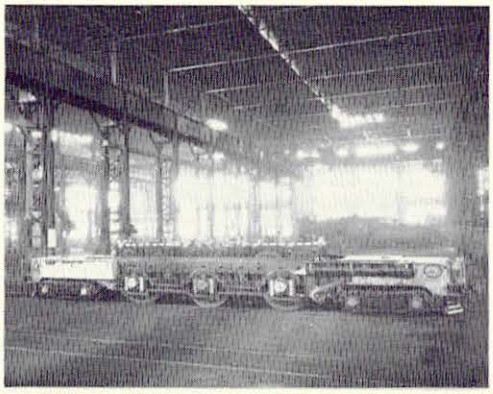
THE Baldwin Locomotive Works congratulates the Pennsylvania Railroad on the establishment of the electrified service between Philadelphia and New York. This marks the completion of the first unit of the 230 miles of electrification which will eventually extend from New York to Washington.

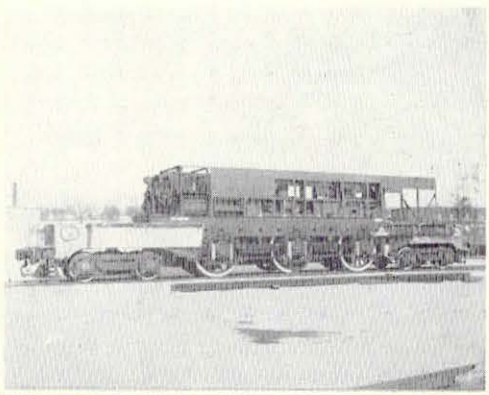
We are proud that many of the locomotives used in this service are, in part, Baldwin products, — the mechanical parts of the Westinghouse locomotives having been built by us for Westinghouse.

Today, more than at any time in our history, we believe we are equipped to assist the railroads in solving their motive power problems.

THE BALDWIN LOCOMOTIVE WORKS
PHILADELPHIA





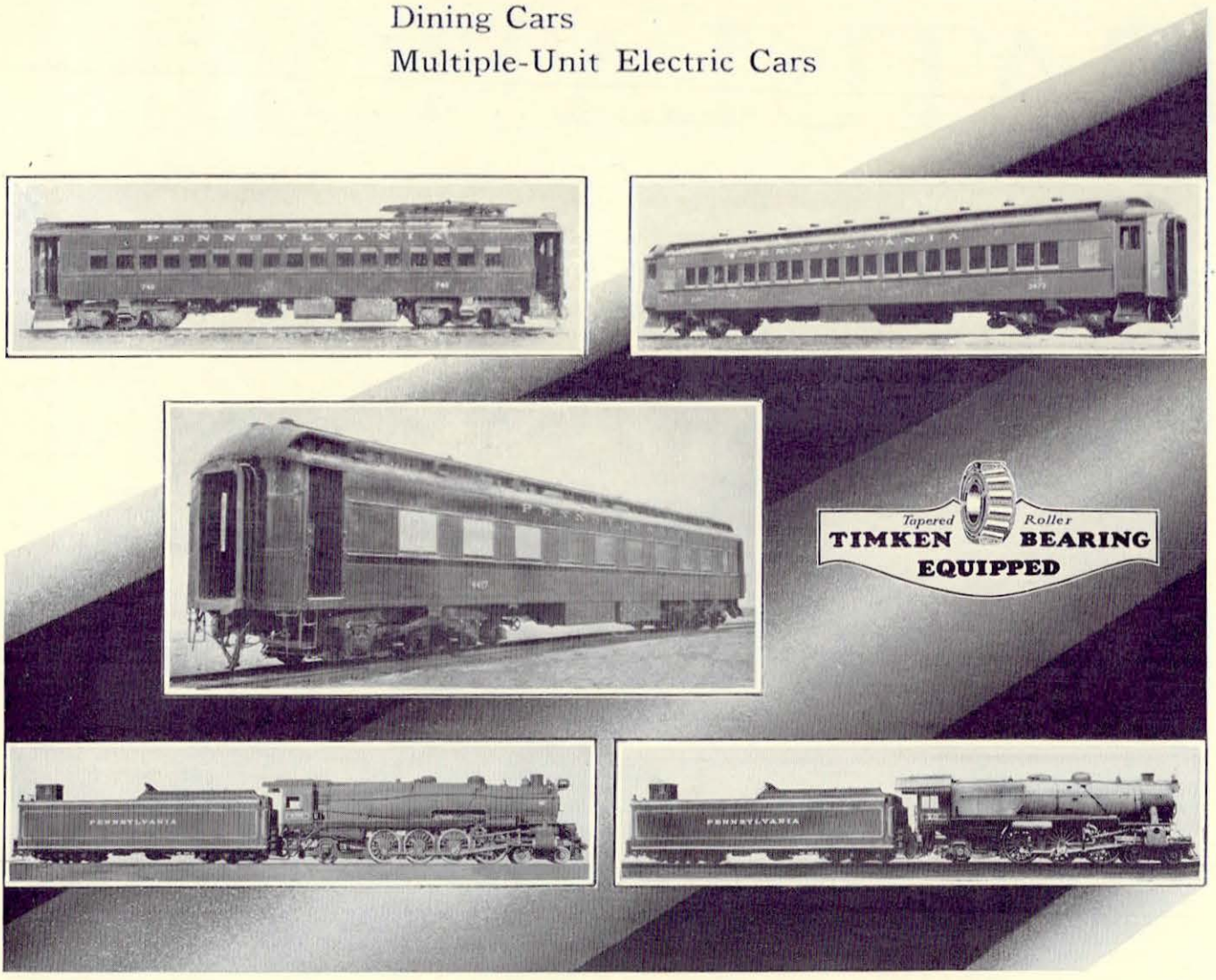


TIMKEN *and the*

Timken Tapered Roller Bearings are used on driver and truck axles of the new electric locomotives which have just been placed in service between New York and Philadelphia on the Pennsylvania Railroad.

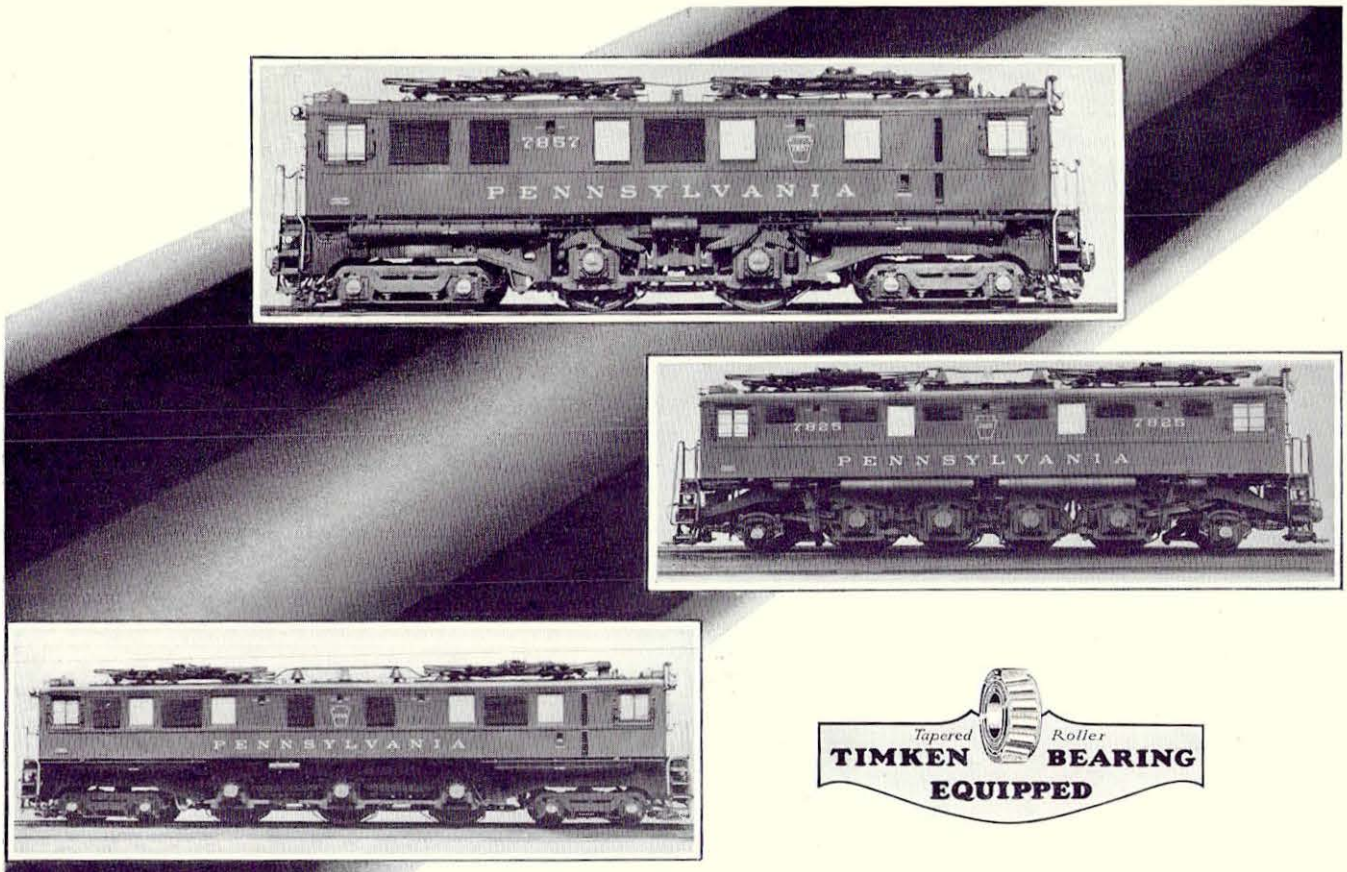
The Pennsylvania Railroad has 396 Timken equipped units in service, as follows:

Electric Locomotives
Steam Locomotives
Steam Locomotive Tenders
Passenger Coaches
Dining Cars
Multiple-Unit Electric Cars



TIMKEN Tapered Roller

PENNSYLVANIA



Tapered Roller
TIMKEN BEARING
EQUIPPED

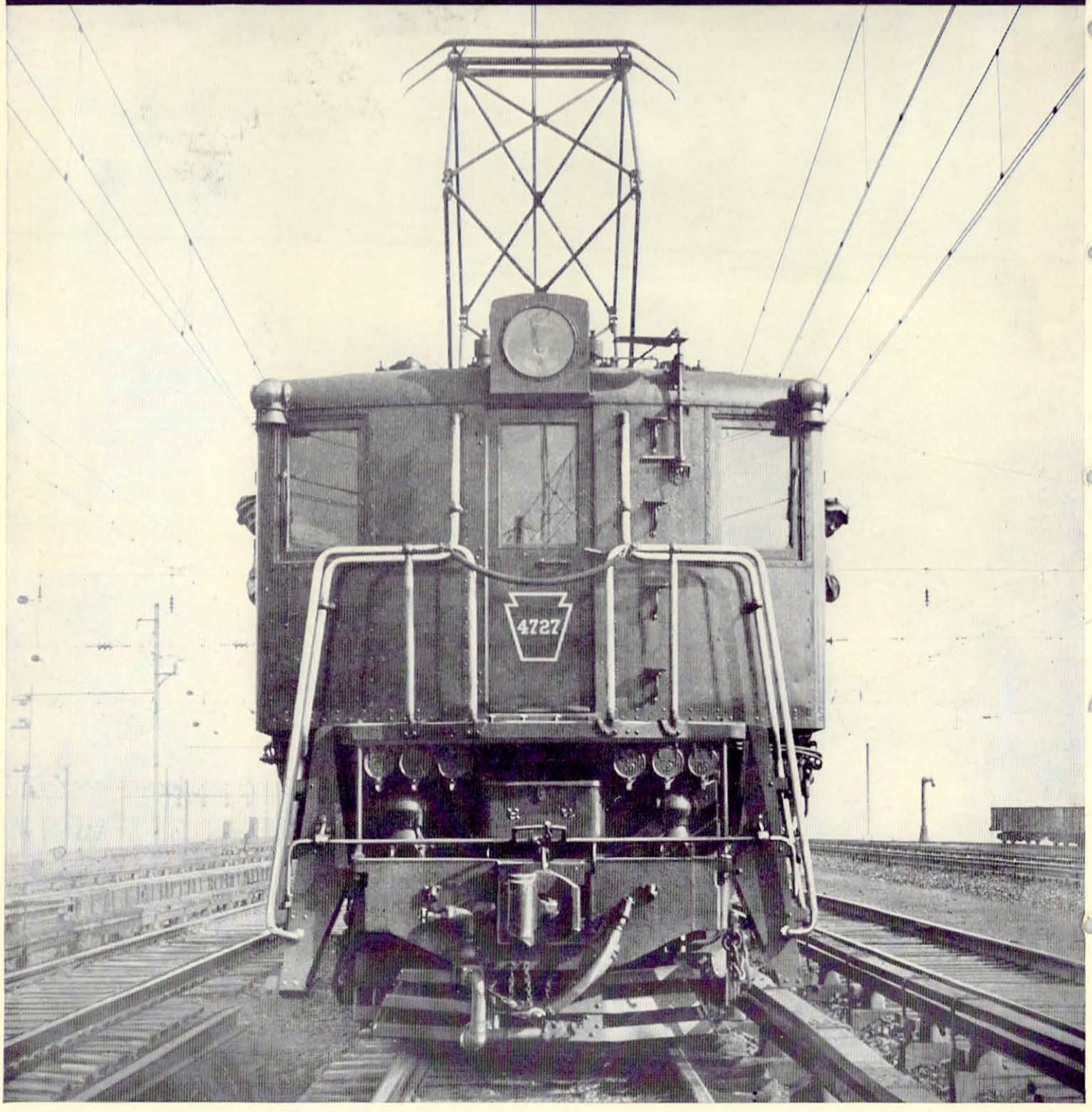
On the Long Island Railroad, also, a number of the multiple-unit electric cars are fitted with Timken bearings on all axles.

The TIMKEN is the ideal railroad bearing, because of its rugged construction, greater radial and thrust-load carrying capacity, and freedom from trouble.

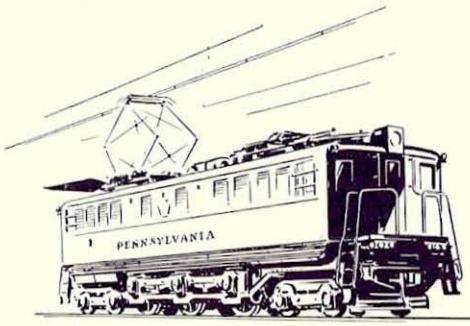
Timken bearings and mountings are now available on existing locomotive engine trucks, trailer trucks, tender trucks and driver pedestal openings, without changing frames, springs or equalizers. The Timken Roller Bearing Company, Canton, Ohio.

BEARINGS

THE PENNSYLVANIA ELECTRIFICATION . . . . . A MODERN



RAILROAD ACHIEVEMENT



THE Pennsylvania electrification project, the most forward-looking and noteworthy railroad development of recent years is typical of the progressive policies that are keeping this railroad abreast of the demands of modern transportation. « This engineering achievement naturally makes use of many advances in design and materials. « Modern transportation needs modern materials. Here Republic metallurgists have been active in developing special alloy steels and irons that give improved physical characteristics. « A new alloy steel withstands shock at low temperatures. « Toncan Iron in the form of sheets, pipe, bolts and plates not only resists rust and corrosion but also withstands the extreme vibration that characterizes modern, high speed operation. « Special alloy steels for axles, pins and other moving parts have higher tensile strength, shock resistance and fatigue resistance. « In this development of modern railroad materials Republic metallurgists have played a prominent part. Bring them your materials problems.

Toncan Iron Boiler Tubes, Pipe, Plates, Culverts, Rivets, Staybolts, Tender Plates and Firebox Sheets • Sheets and Strip for special railroad purposes • Agathon Alloy Steels for Locomotive Parts • Agathon Engine Bolt Steel • Agathon Iron for pins and bushings • Agathon Staybolt Iron • Climax Steel Staybolts • Upson Bolts and Nuts • Track Material, Maney Guard Rail Assemblies • Enduro Stainless Steel for dining car equipment, for refrigeration cars and for firebox sheets • Agathon Nickel Forging Steel.

The Birdsboro Steel Foundry & Machine Company of Birdsboro, Penna. has manufactured and is prepared to supply, under license, Toncan Copper Molybdenum Iron castings for locomotives.

CENTRAL ALLOY DIVISION

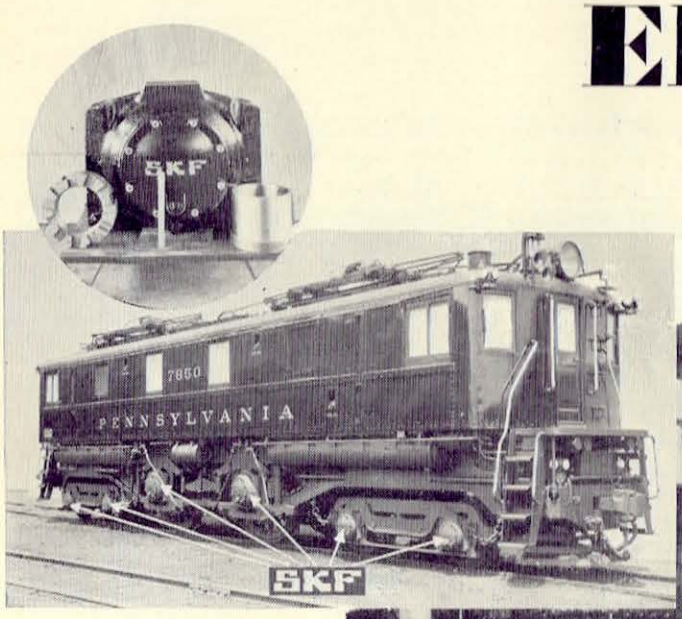
AGATHON STEELS

REPUBLIC STEEL CORPORATION

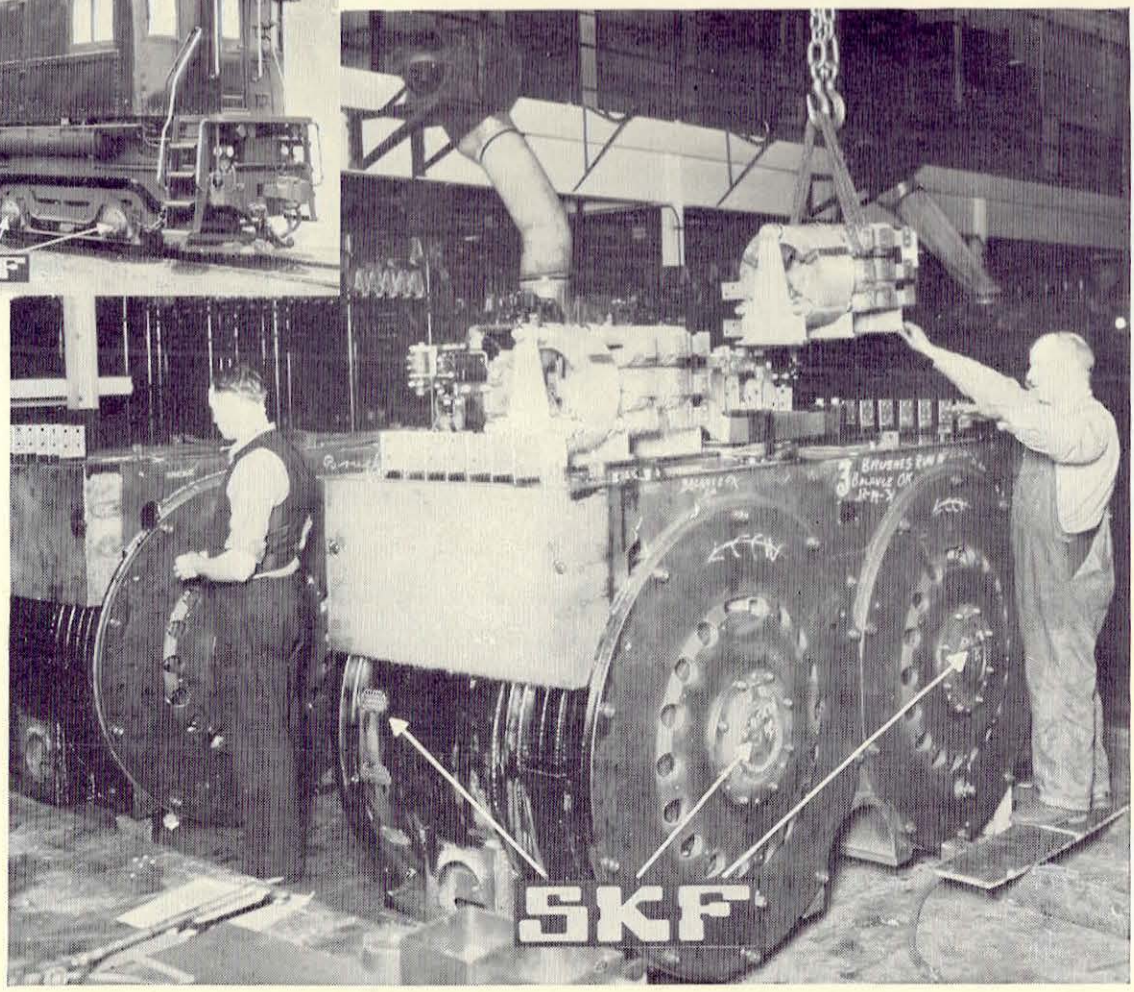
MASSILLON. OHIO

TONCAN COPPER Mo-lyb-den-um IRON

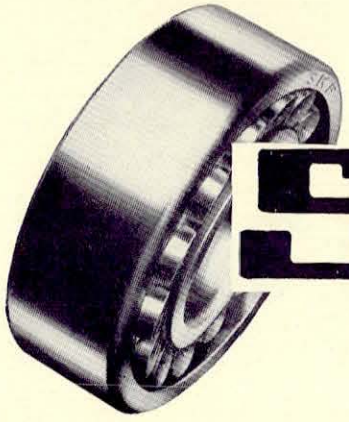
4,000 SKF ELECTRIFIED "KEEP FAITH



Close-up of Driving Box, (over 21 inches in diameter), and parts. Weight 1605 pounds exclusive of axle.



SKF Cylindrical Roller Bearings, 12½" to 15" in diameter are used on heavy duty traction motors for Passenger and Freight Locomotives.



SKF

BEARINGS on PENNSYLVANIA

WITH A GOOD NAME!"

THE SPIRIT OF PIONEERING LIVES

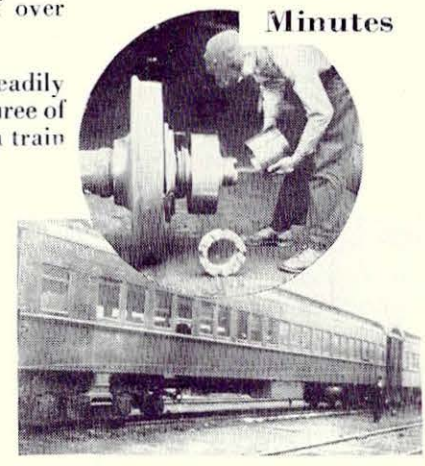
With SKF Who Developed the FIRST Roller Bearing Journal

Forerunner of a mighty caravan of giant electric locomotives in the modernization and electrification program . . . from New York to the nation's capital . . . the O-1 type is the first electric locomotive ever built having roller bearings on all journals and motors. The SKF Bearings on this installation have already rolled up a total of over 100,000 miles of satisfactory road test service.

Tapered sleeve permits bearing to be **REMOVED** *in* **30 Minutes**

Yet, the SKF Bearings on the O-1 are only a comparatively small portion of over 4,000 SKF Bearings which will make anti-friction bearing history.

The responsibility and magnitude of the job anti-friction bearings must do is readily visualized when one considers that every P-5 passenger locomotive, powered with three of the giant twin motor driving units as shown, has the ability to pull a solid Pullman train of 14 cars at the rate of 90 miles an hour!



Only a record of achievement could lead to the selection of anti-friction bearings for this great undertaking. Here, every demand, every test, becomes doubly intensified. Here, bearing dependability of the utmost degree, alone will do for a job of this magnitude. And so it is with friction . . . that must be kept at a minimum. Smooth, easy running is highly important, too. Bearing wear and adjustments must also be eliminated . . . for that means the maintenance of close tolerances, longer life of related parts, higher electrical efficiency, reduced maintenance and repairs.

And to top all these exacting requirements is the demand for ruggedness and stamina to fully cope with day and night brute service . . . the kind of service where failure cannot *and will not be tolerated.*

SKF keeps faith with a good name by delivering all these things, the kind of stand-up-ability that leaves no room for doubt. That is the story of over 4,000 SKF Motor and Journal Bearings on the great Pennsylvania electrification project. And though, only a small part of the whole, SKF's play a vital role in safeguarding a huge investment.

SKF INDUSTRIES, INC., 40 East 34th Street, New York, N. Y.

3012

1921-1933

1,100,000

MILES

TWELVE YEARS . . . and still at it! MORE than 1,100,000 miles of unfailing performance. That's the record of SKF Journal Bearings on Pennsylvania coach No. 4925. Through all kinds of weather these bearings have kept going, insuring safe, dependable, economical railroading . . . without delays . . . without trouble or adjustment. It is a record for continuity of service *unapproached by any other bearing.* And car No. 4925 is only one of 298 so equipped, a total of 2740 SKF Bearings . . . because nothing takes the place of performance . . . and

JOURNAL BEARINGS

PERFORMANCE that *Smiles* at PRICE TAGS!

PENNSYLVANIA ELECTRIFICATION

DEMANDED QUALITY PRODUCTS

THE Pennsylvania A. C. electrification is a tremendous project, nobly conceived and ably executed—truly another great forward step in transportation.

The Railway Steel-Spring Company naturally takes pride in the fact that its tires and elliptic springs were used for many of the freight and passenger locomotives.

"Railway" Products are quality products. They are the result of constant research and experiment plus practical experience gained by years of actual service and a thorough knowledge of the field.

Railway Steel-Spring Company

30 CHURCH ST., NEW YORK

Branch Offices:

Chicago, Ill. Washington, D. C. Cleveland, Ohio Pittsburgh, Pa. Montreal, Que.
St. Paul, Minn. St. Louis, Mo. Denver, Colo. San Francisco, Cal.

A Great Adventure In Railroad Science

The Pennsylvania Railroad electrification involving an expenditure of more than $100,000,000, covering the heaviest freight and passenger traffic section in the world and embracing many innovations in both practice and equipment, has been called a "great adventure in science." And well it deserves the name.

The new electric locomotives, for example, develop the previously unheard of 1250-hp. per axle. Capable of traveling over 90 miles an hour, they develop maximum horsepower through a wider range of speed than ever before. The Pennsylvania, however, does not "adventure" without being sure. With all of this increase in speed, greater economy and extension of efficiency there has been no neglect of the safety factor. In vital locomotive parts the Railroad knows it must look for metallurgical advance in line with the advance of railroading. Their specifications for materials are written around that knowledge. The Standard Steel Works supplied to the locomotive builders and electrical apparatus manufacturers rolled steel wheels, tires, driving wheel centers and miscellaneous castings and forgings for some of the electric engines, to meet these requirements of the railroad specifications. The Standard Steel Works are therefore contributors to that which will carry this great adventure forward through the years.

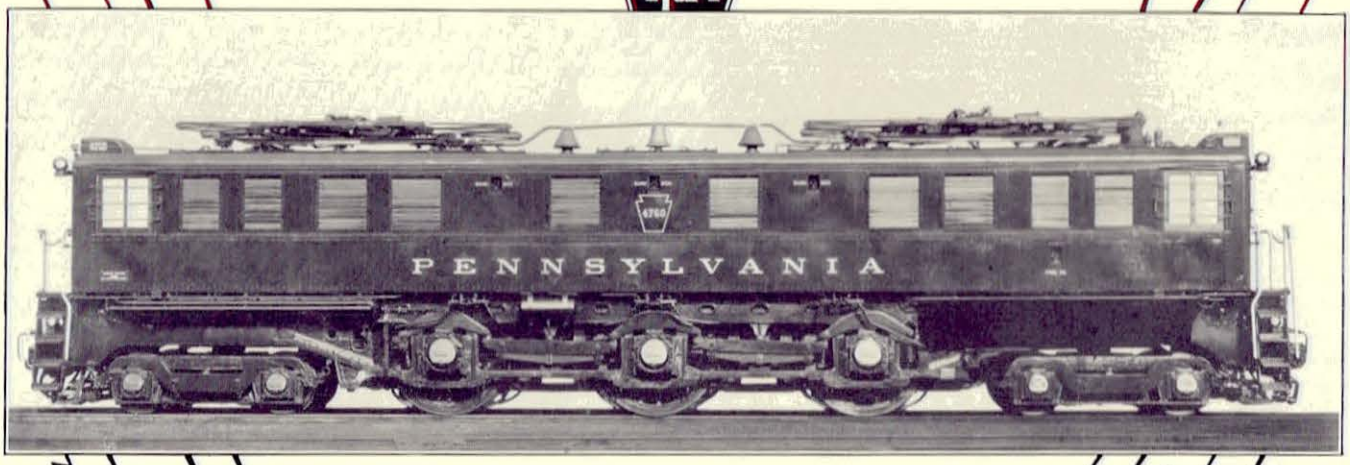
STANDARD STEEL WORKS COMPANY

SUBSIDIARY OF THE BALDWIN LOCOMOTIVE WORKS

GENERAL OFFICES and WORKS: BURNHAM, PENNA.

CHICAGO NEW YORK PHILADELPHIA ST. LOUIS

AKRON PORTLAND SAN FRANCISCO



PENNSYLVANIA RAILROAD ELECTRIFICATION

Marks another epoch in Railway Progress

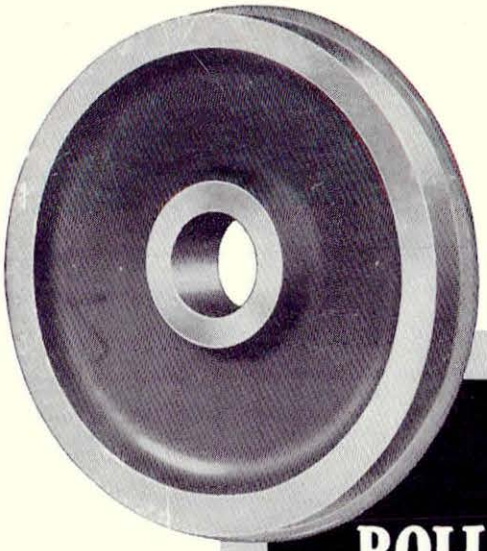
As in this project, valuable economies in the maintenance and operation of rolling stock and other railroad equipment can be had by using "NATIONAL" products.

"NATIONAL" products are made by

NATIONAL MALLEABLE AND STEEL CASTINGS CO.

Manufacturers of
A. R. A. COUPLERS
NATIONAL FRICTION DRAFT GEARS
CAST STEEL YOKES
NATIONAL TRUCKS
SIDE FRAMES
BOLSTERS
NATIONAL JOURNAL BOXES
STEEL and MALLEABLE IRON CASTINGS

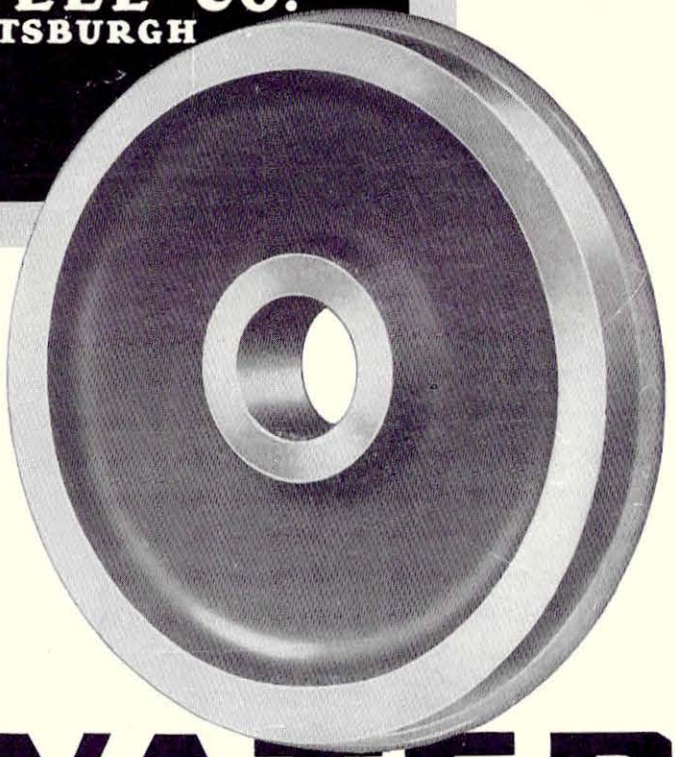
NATIONAL MALLEABLE AND STEEL CASTINGS CO.
General Office — Cleveland, O.



ROLLED STEEL WHEELS

LOCOMOTIVE & CAR WHEEL TIRES

EDGEWATER STEEL CO.
PITTSBURGH



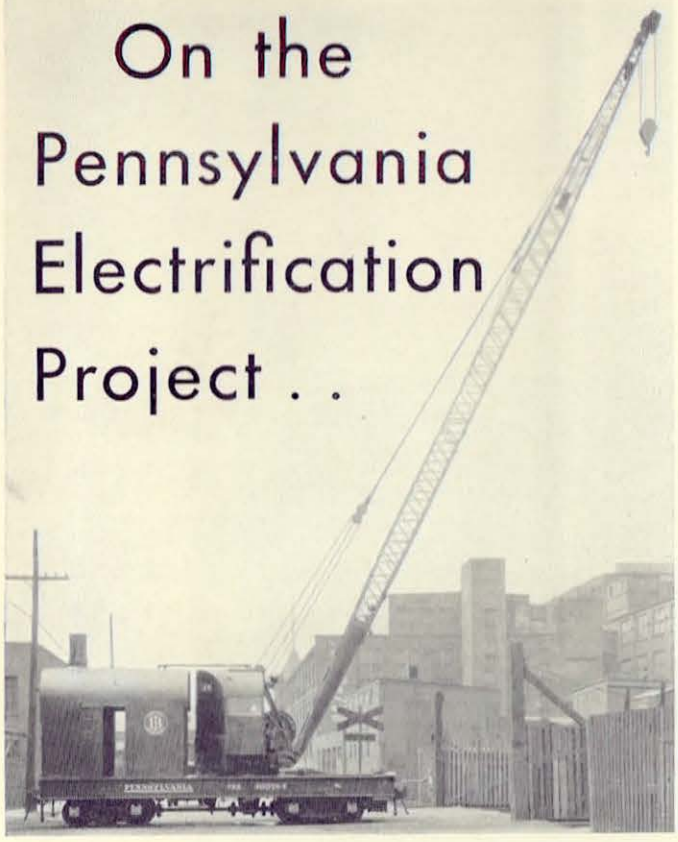
Sales Offices:

Atlanta, Ga.	Philadelphia, Pa.
Baltimore, Md.	San Francisco, Cal.
Boston, Mass.	St. Louis, Mo.
Chicago, Ill.	Seattle, Wash.
Kansas City, Mo.	St. Paul, Minn.
Louisville, Ky.	Washington, D. C.

New York, N. Y.

EDGEWATER

On the Pennsylvania Electrification Project . .



Four Industrial Brownhoist special short-clearance cranes, equipped with 80 foot booms, were used by the Pennsylvania Railroad to set the poles on their great electrification project.

These cranes rotate in a radius of only 5 feet 2 inches from the center of the car. The rear cab, inclosing the boiler, is fixed to the car body.

This design is of great value in railroad service, particularly where work must be handled in close quarters. The short rear overhang permits the operation of passing trains on adjoining track without interfering with crane operation.

INDUSTRIAL BROWNHOIST CORPORATION

GENERAL OFFICES: BAY CITY, MICHIGAN

District Offices: New York, Philadelphia, Cleveland, Chicago

INDUSTRIAL BROWNHOIST

LOCOMOTIVE AND CRAWLER CRANES

BRIDGE CRANES
CAR DUMPERS
BUCKETS
CONVEYORS

Where safety depends on accuracy, International Time Systems are used . . .

Railroad operation hinges on uniform, accurate time. Despatching crack trains . . . passenger and freight handling . . . every activity demands accuracy and coordination, not alone for the maintenance of schedules but for the safety of millions of lives.

International Electric Time used in the new Pennsylvania Stations in Philadelphia has proved its ability to keep "railroad accuracy" even to the split second.

An exclusive, patented feature automatically keeps every clock in these systems on time . . . hand setting and other expensive maintenance is entirely eliminated.

The Pennsylvania Railroad's two new Philadelphia Stations—designed by Graham, Anderson, Probst and White, Chicago Architects. The Suburban Station, shown above, is already in operation. Below is shown the main Terminal Building now under construction. The International Time Systems in both stations will operate in unison when completed.

INTERNATIONAL TIME RECORDING CO. DIVISION

International Business Machines Corporation

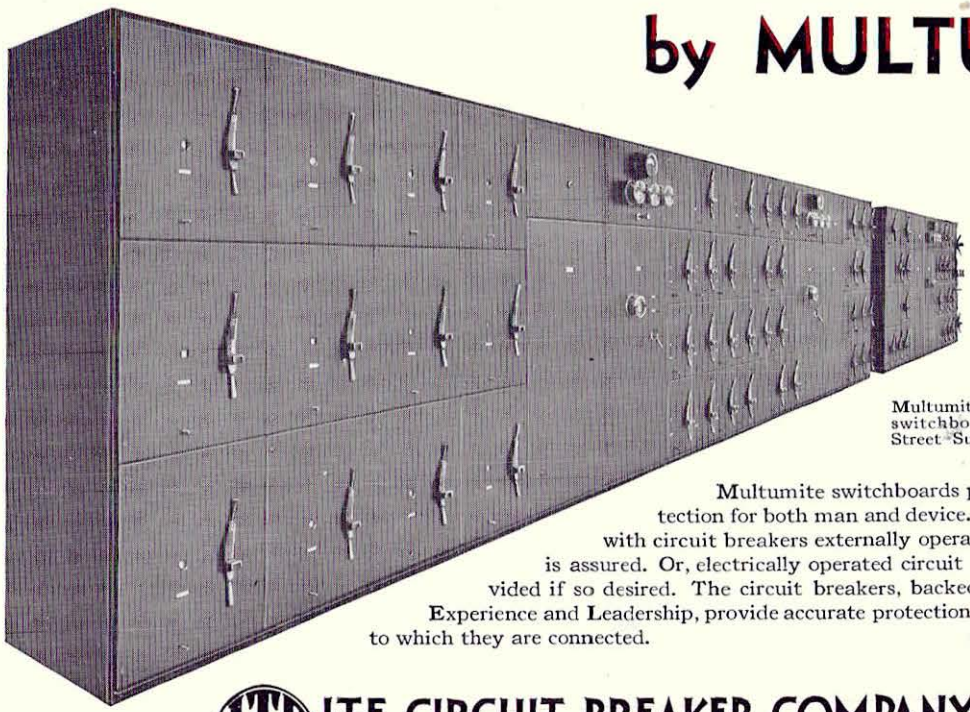
International Time Recorders and Electric Time Systems—International Electric Tabulating and Accounting Machines—International Industrial Scales—Dayton Moneyweight Scales and Store Equipment

GENERAL OFFICES
270 Broadway
NEW YORK, N. Y.

BUSINESS INTERNATIONAL MACHINES

Branch Offices and Service Stations in all Principal Cities of the World

COMPLETE PROTECTION by MULTUMITE



Multumite-Rigite steel enclosed switchboard installed in Broad Street Suburban Station.

Multumite switchboards provide complete protection for both man and device. Totally enclosed and with circuit breakers externally operated the utmost safety is assured. Or, electrically operated circuit breakers may be provided if so desired. The circuit breakers, backed by years of I. T. E. Experience and Leadership, provide accurate protection for device and circuit to which they are connected.

I-T-E CIRCUIT BREAKER COMPANY
19TH AND HAMILTON STREETS · PHILADELPHIA · PA·

Send for Multumite Switchboard Book

CONTRACTORS FOR
PENNSYLVANIA RAILROAD ELECTRIFICATION
BETWEEN
BALTIMORE, WASHINGTON AND POTOMAC YARDS

Our complete organization with years of experience in successfully executing large construction contracts of various kinds is prepared to undertake the construction of earth, masonry and concrete dams, drydocks, dredging of all kinds, river and harbor improvements, deepening channels, hydraulic filling and rock work, tunnels, railroad construction, sewers and waterways.

The Arundel Corporation

Main Office ARUNDEL BLDG. Pier 2, Pratt Street

Baltimore • • • • • Maryland

BRANCHES - NEW YORK CITY - MIAMI, FLORIDA - NORFOLK, VA.

BERMICO FIBRE CONDUIT

Note ease of handling 46 duct feet of Bermico Multiple

BERMICO Fibre Conduit was used by the Pennsylvania Railroad in part of its electrification.

This product is readily adaptable to duct line problems by reason of ease of installation, low total installed cost, and permanency.

BERMICO Regular Conduit, single or multiple, for concrete encased duct lines, and extra strength Super for exposed installations, together with all necessary fittings, meet any railroad duct line requirement.

Write us for descriptive literature, or, better still, let our engineers explain the advantages of our various types of fibre conduit as applied to your problems.

You will be under no obligation.

Distributed by GraybaR ELECTRIC COMPANY

Manufactured by

BROWN Company FOUNDED 1852 *Portland, Maine*

WELDED SEVERAL BRIDGES AND SOME CATENARY IN THE... NEW YORK TERMINAL

ON THE PENNSYLVANIA

THE establishment of the electrified service between New York and Philadelphia by the Pennsylvania Railroad is a crowning achievement in transportation for it marks the successful completion of the first part of their extensive electrification project. It is significant that Hallen Welding Service, Inc., was chosen to execute the important electric welding of several bridges and the welding of some catenary structures under the Post Office Building in the New York Terminal.

Hallen Welding Service, Inc., is organized to handle promptly welding jobs in any part of the United States and Canada. All our work is guaranteed.

HALLEN WELDING SERVICE, INC.
45-24 37 St. LONG ISLAND CITY

DU-WEL

TI-ANGLE
(PATENTED)

ONE PIECE GUARD RAIL

Manganese and Special Alloy Steel

DURABLE, ECONOMICAL

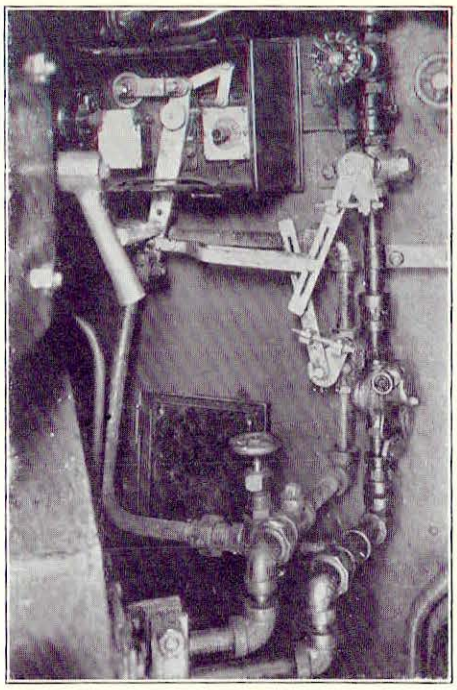
DU-WEL STEEL PRODUCTS CO.
GENERAL OFFICES
RAILWAY EXCHANGE BLDG.
TELEPHONE HARRISON 8257
Chicago

THE ROBOT FIREMAN

THE electric locomotives for main line passenger service on Pennsylvania Railroad are equipped with oil fired boilers for steam heating the trains. The A. T. C. Co. control equipment is used to meet the exacting requirements on P. R. R. Electric Locomotives. The steam heating boilers are entirely automatic and include control of fuel oil, steam for atomizing and air for combustion, so operated as to maintain a clear stack under varying conditions of firing.

The control equipment is electrically interlocked for low water safety cut out and for fuel pressure failure and it automatically takes up low fire valve settings if the main power circuit is opened when crossing bridges or passing water towers.

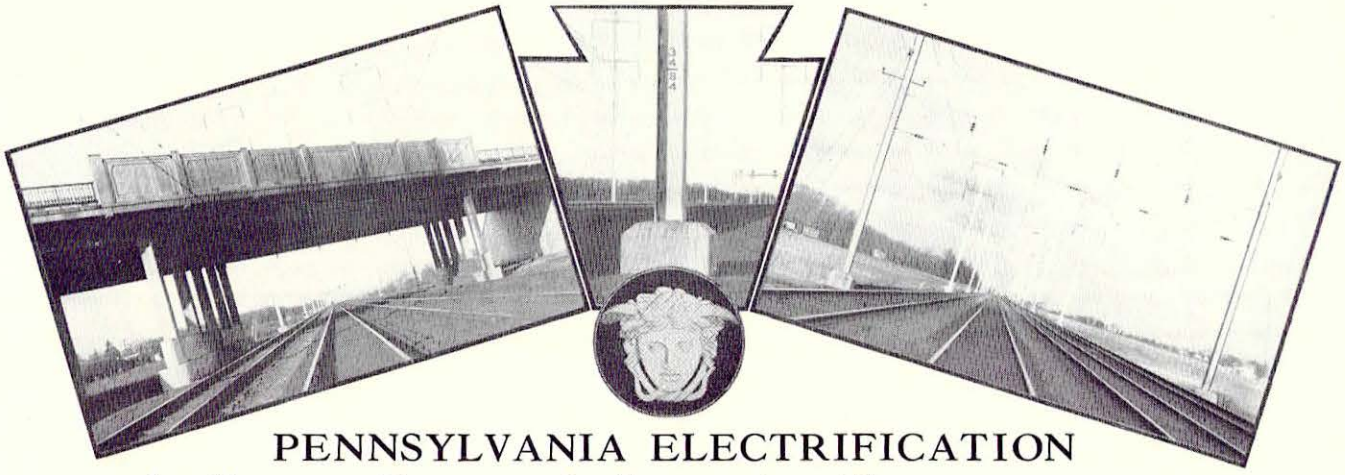
The A. T. C. Co. has pioneered in automatic temperature control for industrial furnaces for the heat treatment of steel, etc., and also specializes in automatic control of pressure, level, flow and time cycle.



A. T. C. Controller showing fuel oil and steam valves as mounted on locomotives.

AUTOMATIC TEMPERATURE CONTROL CO., INC.

34 East Logan St., Philadelphia, Pa.



PENNSYLVANIA ELECTRIFICATION

A Great Forward Step in Transportation

CEMENT played an important part in this epoch-making achievement. Where loads are heaviest and service hardest and where reliability and permanence are prime requisites, engineers and designers turn to Cement for the stand-up-ability they must have. That is why Cement was used so extensively for stations, platforms, viaducts, catenary supports, bridges, foundations, etc.

Medusa Portland Cement is particularly advantageous for this work because it sets quickly, prevents disintegration and is unaffected by exposure.

MEDUSA PORTLAND CEMENT CO.
1002 Engineers Bldg. Cleveland, Ohio

Manufacturer of Medusa Gray Portland Cement (Plain and Waterproofed); Medusa Waterproofing (Powder or Paste); Medusa White Portland Cement (Plain and Waterproofed); Medusa Portland Cement Paint; Medusa-Mix, and Medusa-StoneseT, the Masonry Cements.

MEDUSA

CORKBOARD

PIPE COVERING — MACHINERY ISOLATION

WHEN the Pennsylvania Railroad needed corkboard for roof insulation on its new terminal at 30th and Market Streets, Philadelphia, Corinco was used. Over 200,000 feet of this pure vegetable corkboard went into the construction of this new building as well as Corinco Pipe Covering and Machinery Isolation. Insulating Efficiency is what counts and Corinco has IT. Corinco Products are made in the United States.

Let our engineers solve your insulating problems

CORK INSULATION CO., INC.

GENERAL OFFICES
154 Nassau St.
New York, N. Y.

FACTORY
Wilmington, Del.

BRANCHES

Philadelphia
Washington
Boston
St. Louis
St. Paul
Los Angeles
San Francisco
Seattle
Chicago
Corinco Insulation Co., Inc.

AT SPEED IT'S EASY TO MISS-

—Seeing the DELTA-STAR 7.5 K. V. to 132 K. V. Manual and Motor Operated Disconnecting Switches Installed on Steel Towers and Poles, But There are Nearly a Thousand on the Line Between

PHILADELPHIA AND NEW YORK

DELTA STAR
ELECTRIC CO.
CHICAGO
TRADE MARK - REG. U.S. PAT. OFF.

To the Owners, Executives and Employees
of the Pennsylvania Railroad Company

Your achievement, in the electrification of suburban and long distance railroad service, adds convincing testimony to your claim of leadership . . . May your success be properly proportionate with the great pioneer work you are doing in the field of major transportation.

The Republic Rubber Company
Youngstown, Ohio

Railway Supply Division of Lee of Conshohocken . . . February 15, 1933

Treated Timber With Lifetime Strength and Permanency

The uniform high quality of our treated timber gives lifetime satisfaction . . . and low yearly average cost.

Nationwide Timber Service

Treatments by standard processes with standard preservatives.

OUR PRODUCTS: Railroad Cross Ties, Car Stock, Bridge Timbers, Piling, Posts, Poles, Structural Lumber, Mine Timbers, Cribbing, etc.

AYER & LORD TIE CO. — **Chicago, Ill.**

CENTURY WOOD PRESERVING CO. — **Pittsburgh, Pa.**

NATIONAL LUMBER & CREOSOTING CO. — **Texarkana, Ark.-Tex.**

AFFILIATES OF
THE WOOD PRESERVING CORPORATION
Koppers Building, Pittsburgh, Pa.

Eighteen Sales Offices — Twenty-One Treating Plants

GOLD CAR HEATING & LIGHTING COMPANY

INVENTORS AND MANUFACTURERS OF

ALL TYPES OF STEAM AND ELECTRIC HEATING
SPECIALTIES FOR RAILROAD EQUIPMENT

220 - 36TH STREET
BROOKLYN, N. Y.

Used On the Electrification Project of the Pennsylvania Railroad

LOWELL WRENCH COMPANY
WORCESTER, MASS.

Manufacturers of
Reversible Ratchet Wrenches
All sizes to 6 feet long for construction work

Also
"LOWELL" Reversible Ratchet Sleeve Twisters for both copper and ACSR Conductor

Send for Catalog P.

PENNSYLVANIA ELECTRIFICATION

IN this electrified district LAMBERTVILLE TRAP ROCK is used for ballast under many miles of track which has the distinction of carrying the heaviest freight and passenger traffic in the world.

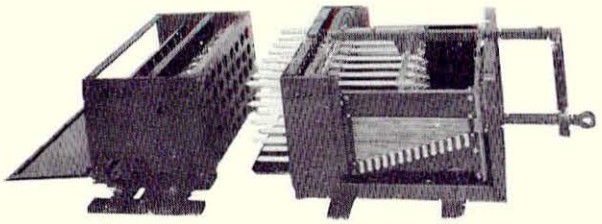
LAMBERTVILLE TRAP ROCK CO.

Lambertville New Jersey

Pittsburgh Standard Galvanized Conduit was used on this installation

Enameled Metals Co.
PITTSBURGH, PA.

STILES DRAWBRIDGE CIRCUIT CONTROLLERS



We manufacture drawbridge circuit controllers for Electric Traction track and signal circuits up to 2,500 amperes and 15,000 volts and more if required. The illustration shows Low Voltage Type.

ON THE PENNSYLVANIA

WE congratulate the Pennsylvania Railroad on the completion of the New York to Philadelphia section of their $100,000,000 electrification program.

We are indeed proud of our installations of circuit controllers on the Hackensack, Passaic Rivers and Newark Bay bridges. They function with unfailing reliability—a positive closure of all circuits upon the completion of bridge movements.

T. GEO. STILES COMPANY

ARLINGTON *Main Office and Works* NEW JERSEY

Representatives

CHICAGO — A. H. Corporation, Marquette Bldg.
PHILADELPHIA — National Accessories, 214 Harrison Bldg.
BOSTON — C. H. Whall Co., 170 Summer St.
NEW YORK — Williams & Isaacs, 30 Church St.
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HAUCK

"VENTURI"

High Pressure Flat Flame Oil Burners

and

Micro Vernier Oil Regulating Valves

are

installed on the boilers of each Penna. electric locomotive which will be placed in service—for furnishing steam to heat the cars and other auxiliary purposes.

This combination of Hauck Burner and Valve provides the very necessary flexibility of capacity and efficiency of operation for this important boiler "service".

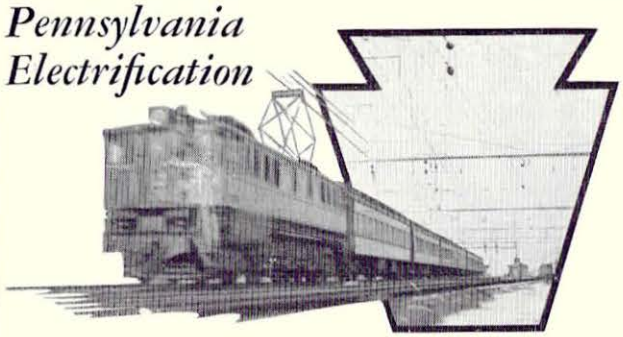
HAUCK MANUFACTURING CO.

Established 1900

Industrial Oil Burners & Oil Burning Equipment

126-134 Tenth Street - Brooklyn, N. Y.

Pennsylvania Electrification



A *BIG* ACHIEVEMENT

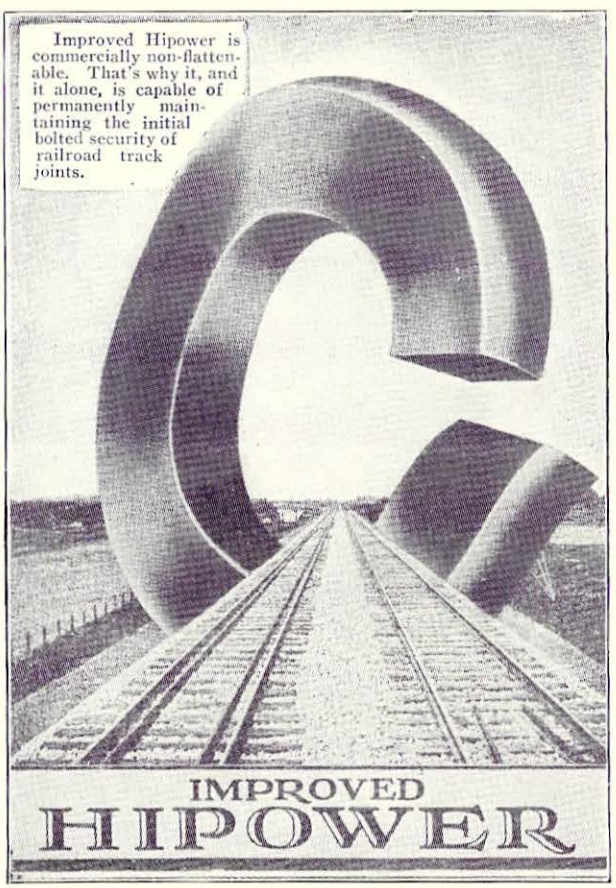
C. G. HUSSEY & COMPANY wishes to tender a deserved tribute to the Pennsylvania Railroad on the successful completion of the Pennsylvania A. C. line — (New York to Philadelphia section) which is the first completed portion of their vast electrification program.

This program will embrace, in its entirety, all train service, both freight and passenger, between New York, Philadelphia, Baltimore and Washington. It is a tremendous project, nobly conceived, requiring foresight and confidence in the future of American railroads.

C. G. Hussey & Company is proud to have participated in this event, by the furnishing of Sheet Copper for this epoch making achievement.

C. G. HUSSEY & CO.

COPPER & BRASS ROLLING MILLS
PITTSBURGH, PA.


Improved Hipower is commercially non-flattenable. That's why it, and it alone, is capable of permanently maintaining the initial bolted security of railroad track joints.
IMPROVED
HIPOWER

THE NATIONAL LOCK WASHER COMPANY

Newark New Jersey

RAILWAY SPECIALTIES CORPORATION

Manufacturers of Utility and Railway Supplies

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Junction Boxes
Fuse Boxes
Electrical Plugs and Receptacles
Terminals, (Cast Copper)
Copper Connectors
Copper Contacts
Copper Ribbon Fuses
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Flexible Shunts
Axle & Dust Collars

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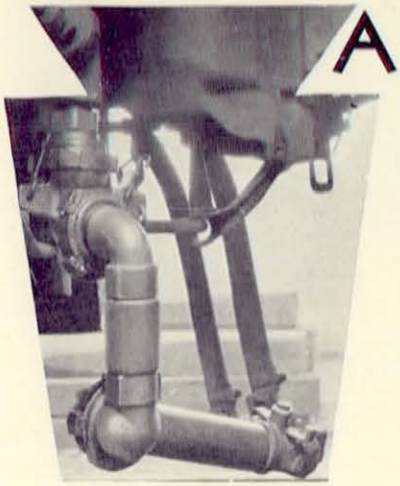
FACTORY
Bristol, Pa.

OFFICE
50 Church Street,
New York, N. Y.



Auto-Tite

Metallic Steam Heat Connectors on the

P. R. R. Electric Locomotives

THE design of the new Pennsylvania A. C. locomotives is regarded to be one of the outstanding achievements in electrical engineering. Passenger units are equipped with AUTO-TITE Metallic Steam Heat Connectors.

American railroads are rapidly standardizing on AUTO-TITE Steam Heat Connectors. Their design insures ample free movement, full capacity in all positions and steam tight performance. Gaskets are easily renewed without removal of joints from pipe connections, proper track clearance is always maintained when units are connected or disconnected.

Auto-Tite Joints Co.
7501 Thomas Bldg. Pittsburgh, Pa.

Pennsylvania Electrification

One of the greatest achievements in electrical engineering.

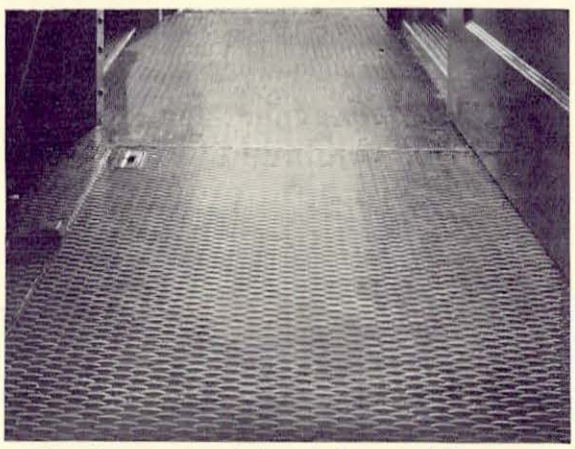
Standard

TRANSFORMERS

Will be found on the job in many important places stepping down voltages from 6,600 v. to 220 v. for signal requirements and for the operation of remote controlled air-break switches used on the 11,000 v. distribution lines.

STANDARD TRANSFORMER CO.

WARREN
OHIO



Safety Engineers satisfied with the non-skid properties of "A.W." DIAMONDETTE FLOOR PLATE use it for passenger car vestibules and trap doors. They find the pattern of equal value when applied to other ferrous and non-ferrous metals as used on the decks of the new PENNSYLVANIA RAILROAD ELECTRIC LOCOMOTIVES.

107 Years Iron & Steel Making Experience

ALAN WOOD STEEL COMPANY
CONSHOHOCKEN, PENNSYLVANIA

PHILADELPHIA
NEW YORK
HOUSTON

ALAN WOOD STEEL CO. ESTABLISHED A.W. 1826 CONSHOHOCKEN, PA.

SAN FRANCISCO
SEATTLE
LOS ANGELES

PENNSYLVANIA ELECTRIFICATION

WE wish to congratulate the Pennsylvania Railroad on its engineering achievement and important contribution to the Nation's transportation facilities.

McNICHOL PAVING & CONSTRUCTION CO.

General Contractors

1923 CHERRY ST. PHILADELPHIA, PA.

R. J. McCREARY LUMBER CO.

MONTGOMERY, ALABAMA

LONG LEAF YELLOW PINE — CYPRESS
SHORT LEAF PINE — HARDWOODS

FOR twenty years we have kept abreast of the marching events of progress, supplying these Woods in all shapes, sizes and lengths—and grades—to major undertakings such as the Great Electrification Project of the Pennsylvania Railroad. We take pride in having contributed a share towards this modern accomplishment.

BRANCH SALES OFFICES:

1600 ARCH STREET
PHILADELPHIA

603 W. WASHINGTON BLVD.
CHICAGO

DROP FORGED HARDWARE

YEARS of experience have taught us how to Manufacture Drop Forgings to stand the Rigid Requirements of the Modern Electric Railway Engineer.

The following are a few of our Regular Items used in the Pennsylvania Railroad Electrification Project:

Turnbuckles	Clevis Nuts
Shackles	Loop Nuts
Wire Rope Sockets	Eye Bolts
Wire Rope Thimbles	Coupling Nuts

Manufacturers
For Over a Quarter of a Century

Maine Steel Products Co.
South Portland Maine

DUCTILITY

is a Paramount Feature of

SWEET'S Grade A-1 Concrete Reinforcing Bars

This cut illustrates Cold Bend Tests actually performed under the personal direction of many eminent engineers.

A complete description of the most modern process of manufacturers will be gladly sent upon request.

SWEET'S STEEL CO.
manufacturers
Williamsport, Pa., U. S. A.

THE ACME MACHINERY COMPANY
Manufacturers of
Acme Bolt Heading
Upsetting & Forging Machinery
Acme Bolt Threading & Nut
Tapping Machinery
Cleveland, Ohio

AIR REDUCTION SALES CO.
Oxyacetylene Cutting and Welding
Equipment and Supplies
General Offices: 60 East 42nd St., New York
See page 34

ALBERT TIRE CO.
Quality and Service Since 1919
857 No. Broad St.
Philadelphia, Pa.

ALLIS-CHALMERS MFG. CO.
Heavy Electric Traction Equipment
Milwaukee
See pages 28, 29

AMERICAN STEEL & WIRE CO.
Power Bonds
Chicago New York
Worcester Baltimore
and all principal cities
See page 26

THE ARUNDEL CORPORATION
Contractors
Baltimore Md.
Branches - New York City - Miami, Fla. - Norfolk, Va.
See page 55

THE AUTOMATIC LITE CO.
Emergency Torches
Baltimore, Md.
See page 68

AUTOMATIC TEMPERATURE CONTROL CO., INC.
Regulation of Temperature, Pressure, Level, Flow, Time Cycle, etc.
PHILADELPHIA, PA.
See page 57

AUTO-TITE JOINTS CO.
Metallic Steam Heat Connectors
7501 Thomas Bldg.
Pittsburgh, Pa.
See page 62

THE BALDWIN LOCOMOTIVE WORKS
Locomotives
PHILADELPHIA PENNSYLVANIA
See pages 42, 43

BRIDGEPORT BRASS COMPANY
Bridgeport, Conn.
Contact Wire — Messenger Wire — Hanger Rods
Cross and Body Spans
Bolts and Nuts — Tru-Loc Fittings
See page 19

BROWN COMPANY
Fibre Conduit
PORTLAND, MAINE.
See page 56

A. M. BYERS COMPANY
Wrought Iron Pipe
Pittsburgh, Boston, New York, Philadelphia
Chicago, St. Louis, Houston, Los Angeles
Front Cover

CARNEGIE STEEL COMPANY
CB Sections - Rails - Wheels
PITTSBURGH, PA.
See pages 20, 21

CHAMPION BRICK COMPANY
110 East Lexington Street
Baltimore

CHEESMAN-ELLIOT COMPANY
Makers of Technical Paints
639-647 Kent Ave., Brooklyn, N. Y.
Fire Retardant Paint for Wood
Signal Trunking, Capping, Trestles, etc.

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Lumber
26th St. and Susquehanna Ave.
PHILADELPHIA, PA.

CORK INSULATION CO., INC.
Insulation Materials
154 Nassau St.
NEW YORK, N. Y.
See page 58

DELTA-STAR ELECTRIC CO.
Manual & Motor Operated
Disconnecting Switches
Chicago, Ill.
See page 58

JOSEPH DIXON CRUCIBLE CO.
Aluminum Paint
Jersey City, N. J.
See page 32

Electric Steel Castings
for
Electric Locomotives
and
Electrification Equipment
Dodge Steel Company
6501 Tacony Street
Philadelphia, Pa.

GENERAL STEEL CASTINGS CORP.
Locomotive Beds
Granite City, Ill.
See page 39

DU-WEL STEEL PRODUCTS CO.
General Offices:
Railway Exchange Bldg.
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Guard Rails - Compromise Joints - Car Replacers
See our ad on page 56

Gold Car Heating & Lighting Co.
All Types of Steam and Electric
Heating Specialties
220 - 36th STREET
BROOKLYN, N. Y.
See page 60

R. J. EDERER THREAD CO.
Philadelphia, Penna.
Linen Cable Lacing Twine
For
Electric and Switchboard Work

GRAYBAR ELECTRIC CO.
Electrical Equipment and Supplies
Graybar Building
New York
See page 31

EDGEWATER STEEL COMPANY
Rolled Steel Wheels
Locomotive & Car Wheel Tires
Pittsburgh, Pa.
See page 53

HALLEN WELDING SERVICE, INC.
Electric Welding
45-24 37th Street Long Island City
See page 56

ELECTRIC STORAGE BATTERY CO.
Batteries
Philadelphia
See page 30

HARRISON BOLT AND NUT COMPANY
Special Bolts Made from Blue
Print, Sketch or Sample
Harrison New Jersey

EMPIRE CITY IRON WORKS, INC.
10-40 46th Ave., Long Island City, N. Y.
furnished and erected the
ORNAMENTAL IRON
FOR THE NEW 30th STREET STATION
At 30th and Market Streets, Philadelphia, Pa.

HAUCK MANUFACTURING CO.
Oil Burners and Oil Burning Equipment
Brooklyn, New York
See page 61

ENAMELED METALS CO.
Clean Thread Conduit
PITTSBURGH, PA.
See page 60

HOOBER & NULL COMPANY
Painting Contractors
1629 Race Street
Philadelphia, Pa.

THE FIRESTONE TIRE & RUBBER CO.
TIRES
Akron, Ohio
See page 69

C. G. HUSSEY & COMPANY
Copper Sheets
Pittsburgh, Pa.
See page 61

THE FLEMING STRUCTURAL STEEL CO.
ENGINEERS AND MANUFACTURERS
NEW CASTLE, PA.
Congratulations to the P.R.R. on this great achievement. We are proud to have had a part in it.

IMPERIAL PAINT COMPANY
Long Island City, N. Y.
Manufacturers of
Paints and Varnishes
Philadelphia, Pa. New York Boston, Mass.

GENERAL ELECTRIC CO.
Electric Locomotives
and
Electrical Equipment
Schenectady, New York
See pages 22, 23, 24, 25

INDIVIDUAL DRINKING CUP CO., INC.
Drinking Cups
Easton, Pa.
See page 68

INDUSTRIAL BROWNHOIST CORP.
Cranes Buckets Car Dumpers Conveyors
Bay City, Michigan
See page 54

LOWELL WRENCH COMPANY
Reversible Ratchet Wrenches
Hand and Pin Vises
Worcester, Mass.
See page 60

INTERNATIONAL BUSINESS MACHINES CORP.
Time Recorders and Electric Time Systems
270 Broadway, New York
See page 54

LONG LEAF YELLOW PINE & FIR
Timbers & Dimension
Concrete Form Lumber
The LUMBER & MILLWORK CO. of Phila.
3812 York Rd., Phila., Pa.

I. T. E. CIRCUIT BREAKER CO.
Switchboards and Circuit Breakers
Philadelphia, Pa.
See page 55

R. J. McCreary Lumber Co.
Pine — Cypress — Hardwoods
Montgomery Alabama
See page 63

JOSEPH V. KELLEY
General Roofing — Sheet Metal Contractor
S. W. Cor. Merion and Wyalusing Ave.
Philadelphia, Pa.

McNichol Paving & Construction Co.
General Contractors
1923 Cherry St. Philadelphia, Pa.
See page 63

THE KERITE INSULATED WIRE & CABLE COMPANY, Inc.
Insulated Wire and Cables
New York, Chicago, San Francisco
See page 33

MAINE STEEL PRODUCTS CO.
Marine and Industrial Hardware
Sargeant Snow Removal Equipment
South Portland Maine
See page 63

Keystone State Corporation
Philadelphia
Pennsylvania
See page 10

MEDUSA PORTLAND CEMENT CO.
Cement
Engineers Bank Bldg., Cleveland, Ohio.
See page 57

KRAMER WOODWORKING COMPANY
20th & INDIANA AVE.
PHILADELPHIA, PA.
Cabinetwork for New Suburban Station Bldg. and New West Philadelphia Station, Penna. R. R., Philadelphia, furnished by us.

THE NATIONAL LOCK WASHER COMPANY
Improved HIPOWER Spring Washers
NEWARK, N. J.
See page 61

LAMBERTVILLE TRAP ROCK CO.
Ballast
Lambertville, N. J.
See page 60

National Malleable and Steel Castings Co.
Manufacturers of
Friction Draft Gears Cast Steel Yokes
Journal Boxes Bolsters Side Frames
Steel and Malleable Iron Castings
Cleveland, Ohio
See page 52

LIMA LOCOMOTIVE WORKS, INCORPORATED
Locomotives
LIMA, OHIO
See page 70

OHIO BRASS COMPANY
Insulating, Suspending
and
Bonding Materials
Mansfield, Ohio See page 12

LOCKE INSULATOR CORPORATION
Insulators
BALTIMORE, MARYLAND
See page 27

PHILADELPHIA INSULATED WIRE CO.
Philadelphia, Pa.
Manufacturers of
Insulated Wire, Cords, and Cables
For all Electrical Purposes

THE POSITIVE LOCK WASHER CO.
Manufacturers of Genuine
"Keystone" Lock Washers
AVE. A. AND MILLER ST. NEWARK, N. J.

STANDARD TRANSFORMER CO.
Transformers
Warren, Ohio
See page 62

JOB T. PUGH, INC.
Established 1774
Philadelphia, Pa.

Augers & Bits — All Types

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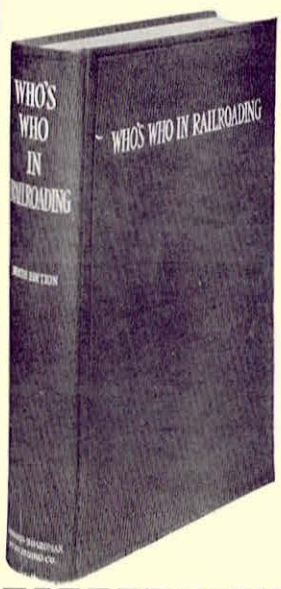

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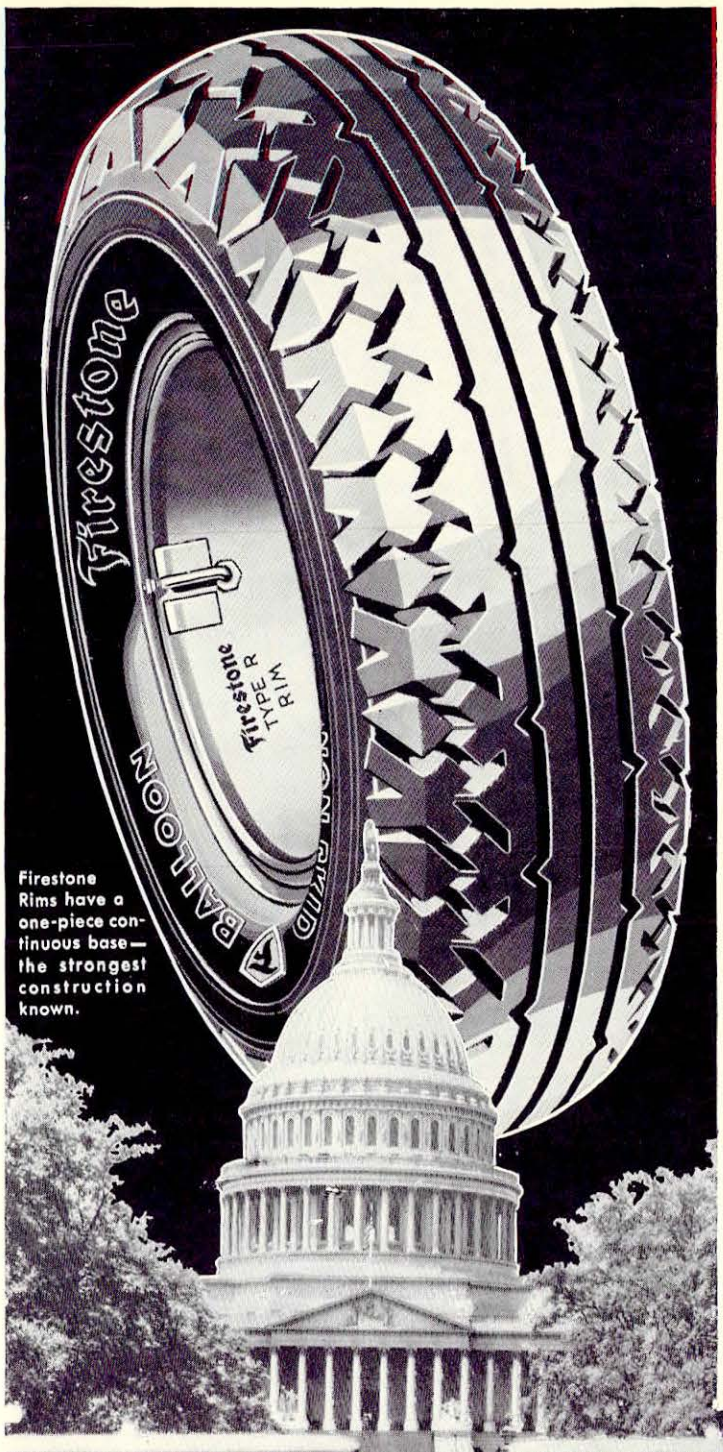

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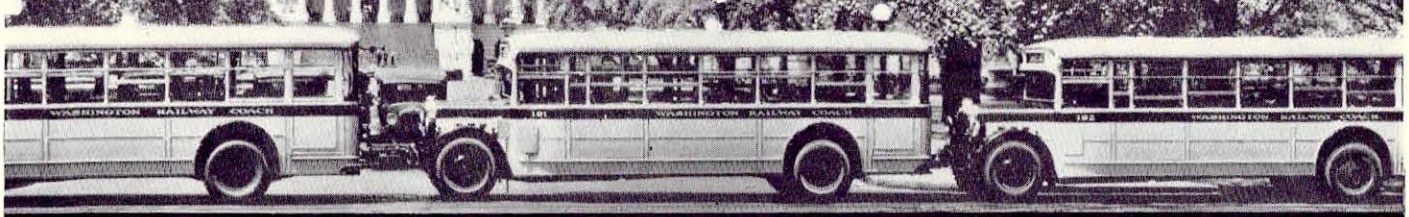

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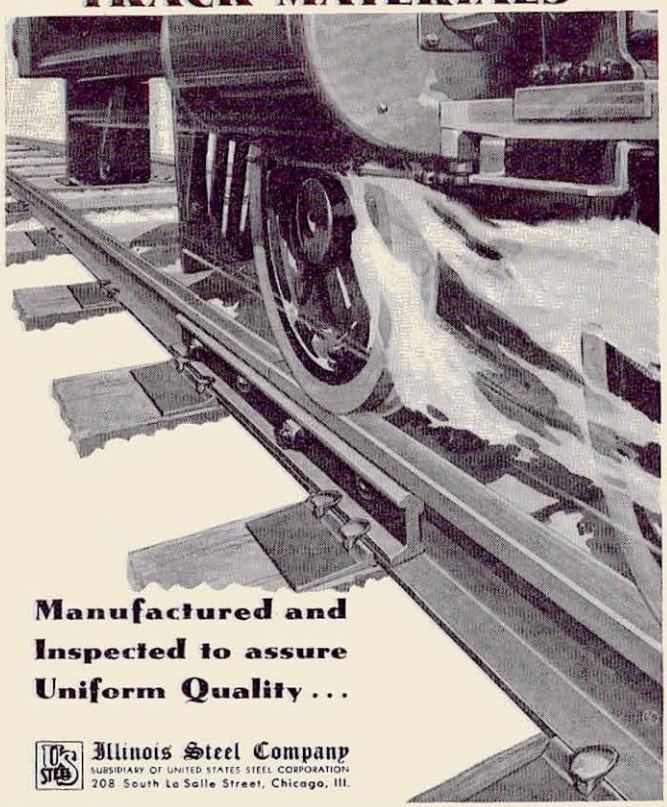

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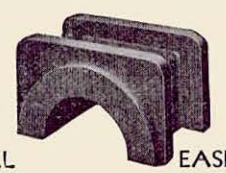

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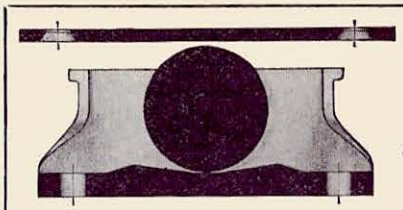

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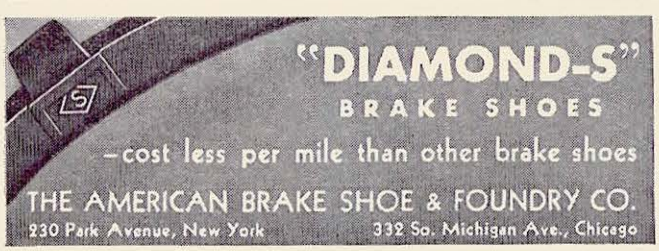
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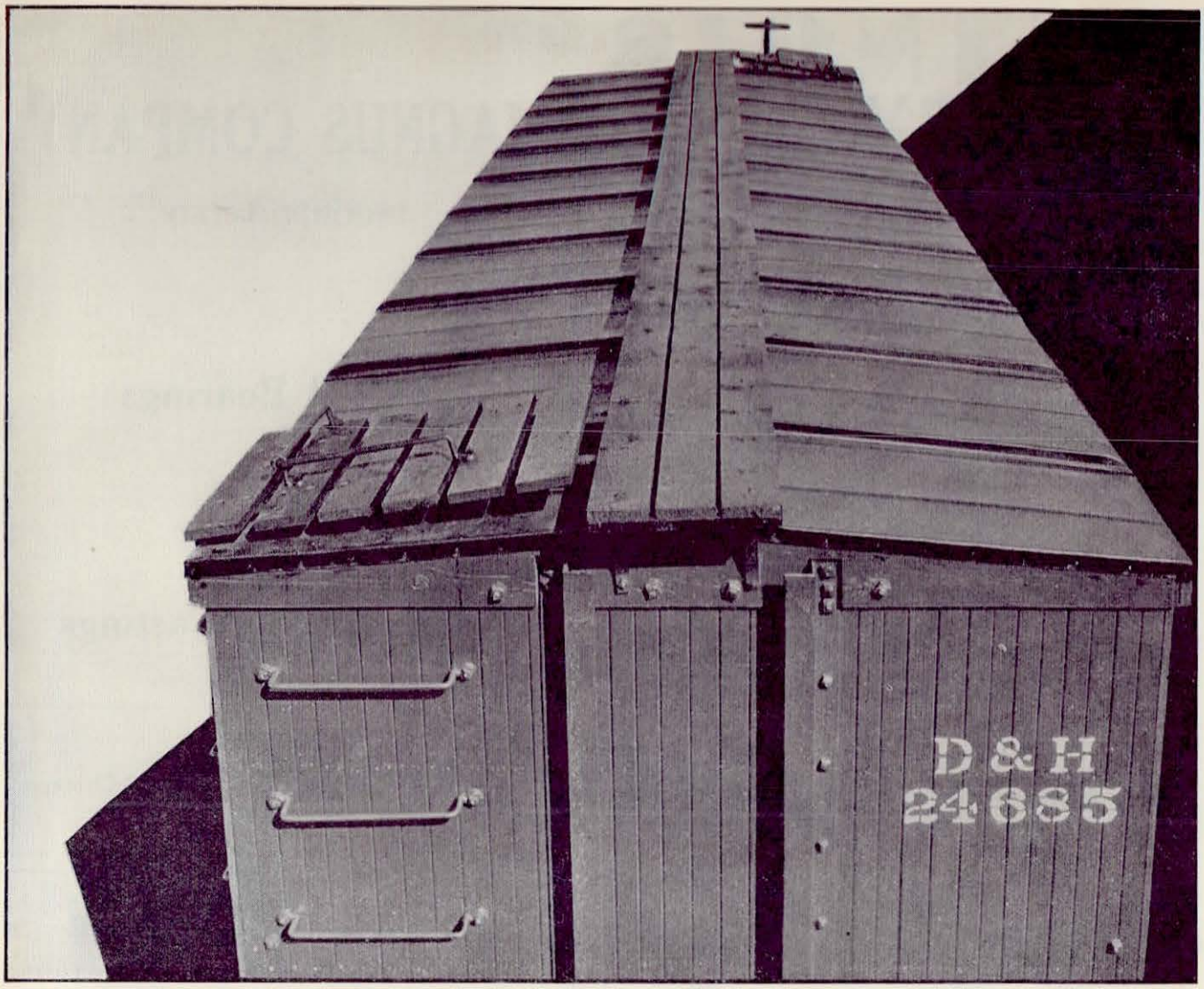

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A Great Railway Electrification Project

The Pennsylvania electrification, which now links the cities of Philadelphia and New York, is a carefully planned engineering project which has been carried on through a period of depression without sacrifice of the features which insure its ultimate success. A detailed study of the kinds of traffic which flow over this line indicates that future demands will require increase of capacity which electrification provides.

Years ago, the Pennsylvania engineers foresaw the possibilities of the single-phase alternating-current system and they have adapted important engineering developments in both the electrical and railroad industries to meet the requirements of a railroad electrification which would combine the features of powerful high-speed motive-power units to meet present and future service requirements, dependable electric power supply, and simplification which insures against failure, allows maximum interchangeability of equipment and reduces maintenance to a minimum. Not all of the required equipment was available and to provide for such needs the railroad accomplished an unprecedented step by inducing the manufacturers to combine their best engineering talent to produce those things that were needed to fulfill the plan. An article in the text pages tells how the electrification was accomplished and a special section in the advertising pages affords specific information concerning some of the products and services used.

The first section of line included in the present Pennsylvania a.c. electrification program to use electric motive power was that from Manhattan Transfer, near Newark, N. J., through the two single-track tunnels under the Hudson river to the Pennsylvania station in New York City and through the four single-track tunnels under the East river to Sunnyside yard. This was done in 1910 to provide entry to the New York City terminal which was completed at that time. A direct-current system was installed, but provision was made for changing this to alternating current at some later date, and this was done in connection with the present project. Electrification of suburban service in the Philadelphia area was inaugurated in 1915 and extended gradually until 1932 when it was made to include all suburban service in that area; multiple-unit cars operating from an 11,000-volt alternating-current contact system are used.

In 1928 announcement was made of the decision to electrify the line from New York to Washington, D. C. Work has been proceeding since that time and electric passenger service between New York and Philadelphia was inaugurated on January 16, 1933. Trains are also moved by electric locomotives as far south as Wilmington, Del., and westward to Paoli, Pa. Electric operation will be gradually extended to include freight as well as passenger trains and when completed, its advantages will be fully realized as duplicate services can then be discontinued and locomotive transfer points within the electrified zone dispensed with.

Exclusive of tunnel and terminal requirements, the greatest advantage offered by electrification has always been its ability to increase the amount of traffic which could be hauled over a given section of line. For this reason it is particularly suitable to the Pennsylvania's New York division and the heavy track structure makes it possible to take full advantage of electric operation. An axle loading of 75,000 pounds allowed the application of greater horsepower than was hitherto available and to realize the potentialities of this condition the railroad induced the manufacturers to combine forces and produce driving motors capable of applying 1,250 horsepower continuously to each axle. Considerably greater horsepower is developed during acceleration and speeds of 90 miles an hour are well within the capabilities of the passenger locomotives.

Many other engineering developments have been brought about through this electrification which will undoubtedly be used to advantage elsewhere. It is still too early to determine what the installation will accomplish in reduced cost of power or in reduction of maintenance or increased capacity of track, but fast suburban services are established in the vicinity of both cities, clean smooth-operating through trains are performing satisfactorily and in all probability schedules will be shortened.

Report of the National Transportation Committee

The opinions of the members of the National Transportation Committee, a summary of whose report was published in the *Railway Age* of February 18, are entitled to much weight. None of them is a transportation expert; but the transportation problem is, in important respects, one for statesmen who will survey it as a whole, rather than for experts who, because of their predilection for this or that agency of transportation, may let the trees obscure the forest. There is not much that is new in the report, but there could not be much new in a report dealing sanely with a problem which has been discussed from every possible angle.

Regional Railroad Systems

Perhaps the most outstanding feature of the report is its recommendation for the consolidation of the railroads into regional systems "looking eventually to a single national system with * * * elimination of all excess and obsolete lines and equipment." The committee evidently was profoundly impressed by evidence indicating that there is excessive competition between the railroads which causes unnecessary operating expenses, and that they should be reorganized to reduce competition among themselves and to enable them better to meet the competition of other carriers.

No brief discussion can deal adequately with a recommendation of such magnitude. It contravenes the letter and spirit of the Transportation act, which contemplate the maintenance of competition between a limited number of large systems in each territory. This paper often has criticized excessive competition between the railways, but we believe the economies that could be effected by regional consolidations which would not deprive many communities of needed railroad service are greatly exaggerated. Furthermore, there never has been so much experience as during the recent period which raised a question as to the advantages of "big business." During the present depression, especially, there has been unprecedented criticism of lack of leadership in both government and business. Has nature ceased to produce capable men, or is it not more probable that men in high places have seemed to lack the qualities of leadership only because the development of gigantic concerns under a single management has presented to them more difficult problems than ever confronted their predecessors?

"Cheaper Alternative Transport Methods"

With the recommendation that "unprofitable railroad service should be replaced by cheaper alternative transport methods" there can be no disagreement. This is in line with other recommendations of the committee, that the railroads should be allowed and encouraged to own and operate carriers by water and highway on the same terms as other companies and persons. The question immediately arises, however, as to what are "cheaper alternative transport methods." There has been, as yet, no satisfactory determination of the actual cost of commercial highway transport. The public provides a highway for the truck, and the cost of providing that highway includes interest upon the investment, maintenance and taxes — in other words, every form of cost that would be involved if truck operators had to provide their own highway. "Automotive transportation," says the committee, "* * * should bear its fair burden of tax, but only on a basis of compensation for public expenditure on its behalf, plus its share of the general tax load." * * * "The automobile itself, its fuel, lubricants and operations are all heavily taxed. Does the total of these assessments bear its share of the general tax load and also sufficiently reimburse the public expenditure on the roads it uses?" What does all this mean? The private automobile and the farmer's light truck make an ordinary public use of the highway. A commercial truck makes a private use of it for private profit. What, then, has the total amount paid by all users of the highways to do with the amount that is or should be paid by those who operate commercial vehicles? We will never know the distances over which highway transport actually is cheaper than rail transport until there has been a determination of the economic principle on which rentals for private commercial use of public highways should be based, and the establishment of rentals on that basis.

Another vital factor in the determination of the comparative cheapness of alternative transport methods is what wages and working conditions are and what they ought to be. It is well known that railway employees enjoy much higher wages and better working conditions than the employees of competing transportation agencies. The committee made no effort to say what the wages and working conditions of employees of any class of carriers should be, but manifestly it believed that some effort should be made to reduce the great inequality between them.

"The Test of Self-Support"

Regarding one important point there can be no question. The committee believed that all classes of competing carriers should pay out of their own earnings all the costs incurred in rendering their services. This is perhaps best illustrated by what it said regarding waterways: "We think that the test of self-support should be applied to every existing or proposed inland waterway. * * * Any project which fails to answer that test should be abandoned without hesitation as an unwarranted waste of public money." Having arrived at the conclusion that transportation by the federal barge line "is in part financed by government," and that proper accounting "would reveal operating losses which are charged to the taxpayer," the committee added: "We think that actual government operation of the facilities of transportation wholly or partly at public expense is unjust to the vast majority of people and unwarranted by any argument that has come to our attention." Such statements show that the committee

believes that every form of subsidy should be withdrawn from carriers both by highway and waterway.

It is impossible briefly to summarize the committee's views on regulation. It said: "Regulatory jurisdiction should be extended to the whole national transportation system, but applied only to the extent necessary for public protection." There will be no dissent from the principle that regulation should be applied only to the extent necessary for public protection; but just what is the minimum amount required? Regulation, said the committee, "should concentrate on protecting the public against discrimination, extortion and other abuses of monopoly and on insuring the most efficient service at the lowest competitive cost." The original objective of railway regulation was the prevention of unfair discriminations consisting principally of the giving in various forms of more favorable rates to some shippers and communities than to others. The unfairness and demoralizing effects of some forms of discrimination were so plain that there was no difficulty in applying the law to them and stamping them out.

There was one form of discrimination the fairness or unfairness of which was, however, difficult to determine, and this was the making of lower rates for a longer than a shorter haul in order to meet competition for the longer haul which did not exist for the shorter haul. Proceeding upon the assumption that it is an unfair discrimination for the railways to make lower rates to meet water competition than they make to communities and territories where there is not such competition, Congress and the Interstate Commerce Commission, by their revision and interpretation of the long-and-short haul law, have deprived the railways of a vast amount of traffic, especially between the Atlantic and Pacific seaboards. Truck operation has now raised the question as to whether it is unfair discrimination to reduce rates to meet competition for short hauls without reducing them for longer hauls. The committee recommended that Congress pass legislation clarifying its policy regarding long-and-short haul rates. We think the committee might well have made more clear its own position.

The discriminations practiced by water and motor carriers are rapidly becoming as demoralizing an influence in commerce as were the same kinds of discriminations when practiced by the railways. We have found nothing in the committee's report which says in so many words that the same law regarding discriminations should be applied to every class of carriers; and yet it is plain that this must be done to establish fair competition and prevent commercial demoralization.

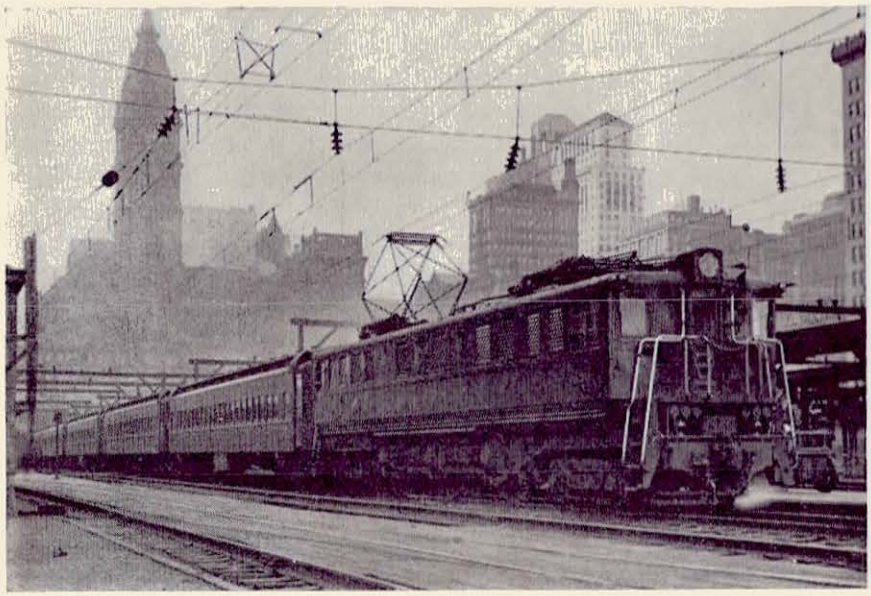
Self-Help by the Railways

The committee urges upon railway managements more general adoption of self-help, and expresses the opinion that the extent to which regulation has reduced the freedom of railway initiative has been exaggerated. At the same time, it implies a lack of vision and initiative by the Interstate Commerce Commission, says regulation should not attempt to "run the business" of transportation, and advocates some reduction of railway regulation, and especially abandonment of the principle of basing rates on valuation. The self-help by the railways suggested would include reduction of competition between themselves and downward readjustment of funded debt and fixed charges.

The doctrine of more self-help is a sound one to emphasize at the present time to all business men, farmers and working men. Never in history, however, has government in this country, federal, state and local, with its manifold interferences in business and excessive taxation, made it so difficult effectively to practice self-help, and in no other industry has it been made so difficult as in the railroad industry. Until the railways recently began getting loans from the Reconstruction Finance Corporation they were the only large industry that received no help from government, and they were handicapped by almost every form of government interference with themselves and government aid to their competitors. Allowing for this fact, railway management during the last decade of both prosperity and adversity, measured by every standard of results, can bear comparison with the management of any other industry, large or small, in the United States. The *Railway Age* discussed railway indebtedness and fixed charges in an editorial in its issue of January 21. That the fixed charges of most companies are too high for such economic storms as the present is beyond question —but whoever anticipated such a storm as this, and, in discussing how the railways have been managed, should not the committee have given some consideration to the fact that the ratio of debt to investment declined from 58 per cent in 1910 to 45½ per cent in 1930?

The National Transportation Committee's report is a needed survey of the entire transportation problem. It is, in the main, constructive and helpful. It should help to crystallize public opinion regarding one of the nation's greatest economic problems. But it suggests no definite and easy ways to solve the problem; and, as a matter of fact, there are no easy ways. The principal requisite to a solution is a revival of general business, and this can be accomplished only by a cessation of the cowardly paltering of politicians with such questions as government expenditures and inter-governmental debts, and the practice by every class and individual of that self-help the committee recommends to railway managements. Self-help by railway managements will include effecting every reasonable economy in labor costs as well as in the costs of railway competition, which the committee so emphasized, and also continuance of united and energetic action to secure equality of opportunity in competition with all other carriers. If the fight already made for fair treatment of the railways had not been made no report dealing as this one does with regulation and competition in transportation would ever have been written; and progress in future toward a solution of the railroad problem will be accomplished only by those who will plan, work and fight for it.

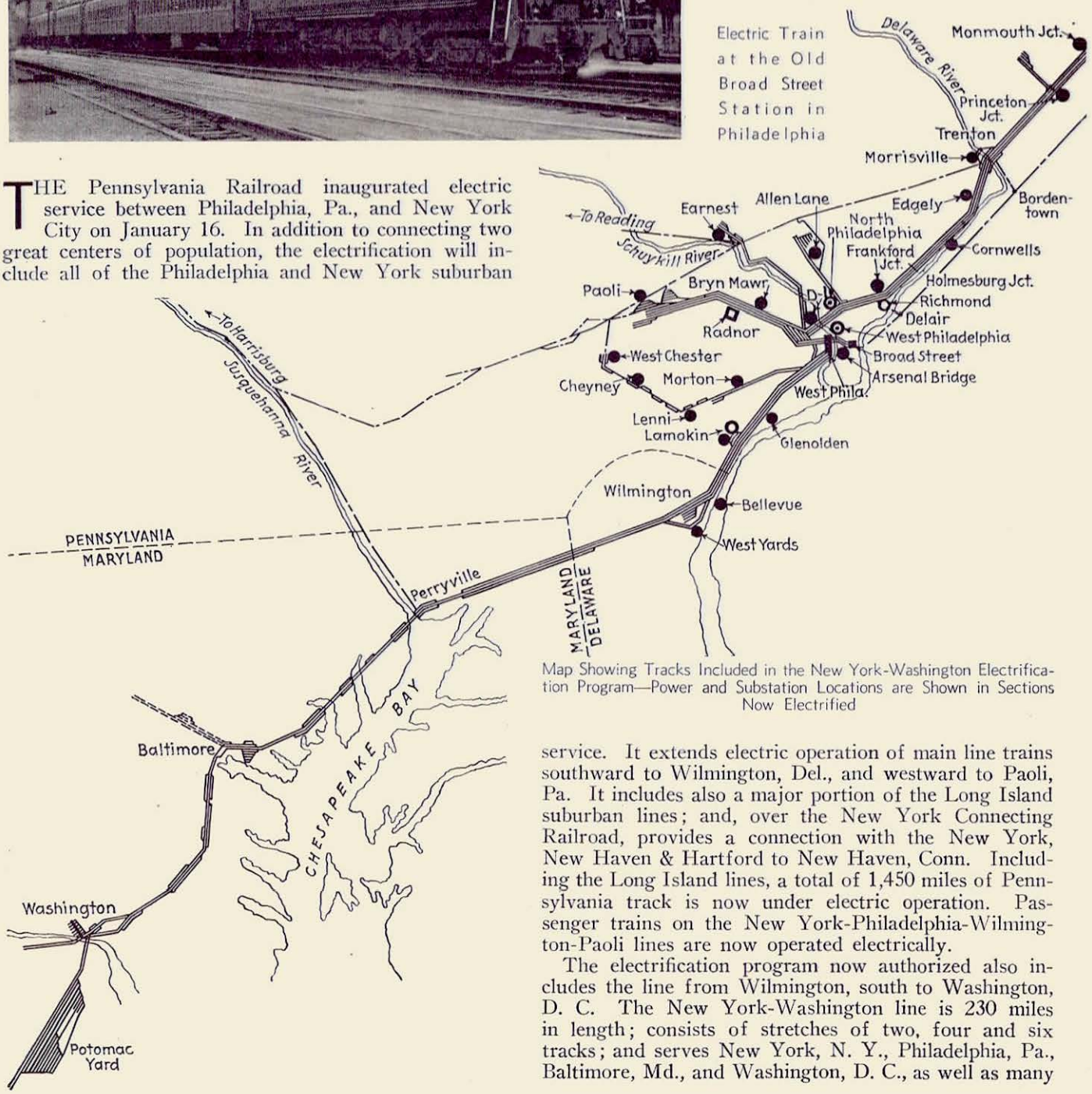
Pennsylvania Electrification Links



Electric Train at the Old Broad Street Station in Philadelphia

Electric territory includes all suburban services in both cities and will be extended to Washington

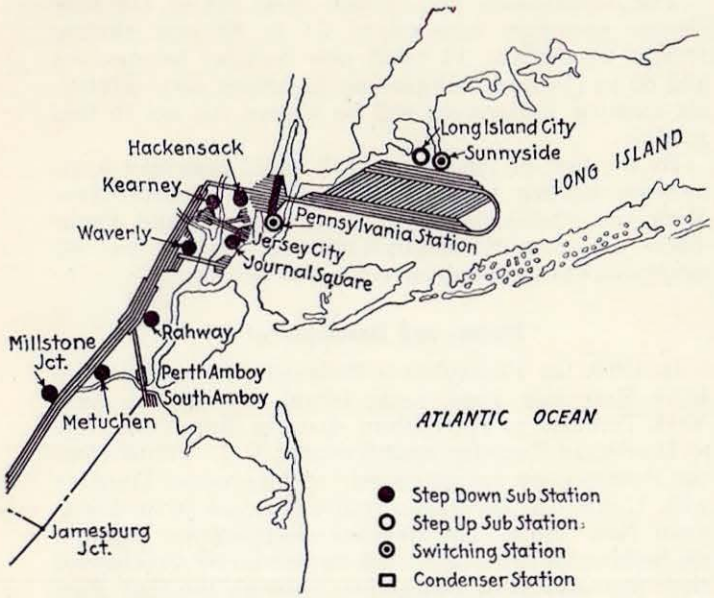
THE Pennsylvania Railroad inaugurated electric service between Philadelphia, Pa., and New York City on January 16. In addition to connecting two great centers of population, the electrification will include all of the Philadelphia and New York suburban service. It extends electric operation of main line trains southward to Wilmington, Del., and westward to Paoli, Pa. It includes also a major portion of the Long Island suburban lines; and, over the New York Connecting Railroad, provides a connection with the New York, New Haven & Hartford to New Haven, Conn. Including the Long Island lines, a total of 1,450 miles of Pennsylvania track is now under electric operation. Passenger trains on the New York-Philadelphia-Wilmington-Paoli lines are now operated electrically.



Map Showing Tracks Included in the New York-Washington Electrification Program—Power and Substation Locations are Shown in Sections Now Electrified

The electrification program now authorized also includes the line from Wilmington, south to Washington, D. C. The New York-Washington line is 230 miles in length; consists of stretches of two, four and six tracks; and serves New York, N. Y., Philadelphia, Pa., Baltimore, Md., and Washington, D. C., as well as many

Philadelphia and New York City



other large and important cities and towns lying between them. It is anticipated that over this piece of railroad there will be a daily electrified train movement in normal times of 60 freight trains and 830 passenger trains, included in which will be 492 multiple-unit trains. This movement represents a freight trailing gross ton-mileage of 10,030,000,000, a passenger car-mileage of 133,575,000, and an electric locomotive mileage of 17,787,000. In addition to this movement, there will be a daily movement of 130 interdivisional freight trains over some portions of the electrified zone, which movement will be electrified as the electrification is extended westward.

A number of non-electrified lines and sidings connect with the electrified territory. The yard freight switching and pick-up movement required to serve these lines and sidings will not at the present time be electrified.

Engineering Developments

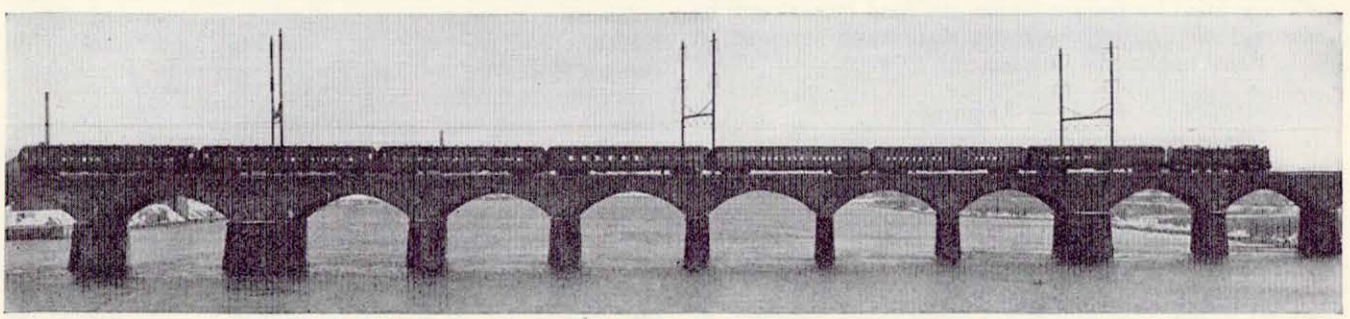
Great courage and long and careful planning have been required to develop a co-ordinated plan and new types of equipment capable of meeting the unusual demands imposed by the service requirements of this busy section of railroad. Years ago the Pennsylvania engineers came to the conclusion that the greatest possibilities for an electrification of this kind lay in the single-phase alternating-current system. At that time there were no motors capable of meeting the requirements of today, but the Pennsylvania management induced the large electrical manufacturers to combine their best engineering talent, with the result that a locomotive

Electric Train Leaving Pennsylvania Station in New York City

motor was produced which develops 625 hp. continuously at the driver rims, over a wide range of speed. At the higher speeds the power is sustained to a degree which has heretofore been impossible in any previous type of traction motor. Similar motors, much more powerful than older types, have also been designed for multiple-unit cars, with the result that one two-motor power truck now provides performance characteristics to a two-car unit which are identical with those of the older equipments, in which one two-motor power truck is used on each car.

Numerous other major improvements have been introduced as the result of the co-operation of the engineers of the electrical companies and the Pennsylvania officers.

Means have been provided for producing all of the necessary power on one phase, instead of two or three, and under normal operating conditions there will be no phase breaks in the contact system—no places where the locomotive must shut off power while it coasts from



Westbound Train Crossing the Four-Track Stone Bridge at Trenton, N. J.

power from one source to power from another. This means that satisfactory methods have been developed for holding single-phase generators, which are separated by great distances, in step or synchronism with each other.

The electric power from the generators is stepped-up to 132,000 volts by transformers and is transmitted along the railroad right-of-way at this voltage to substations placed from 7 to 10 miles apart, where it is stepped-down to 11,000 volts for the contact system. Four parallel transmission lines insure continuity of power supply, and the development of high-speed circuit breakers and relay control has made it possible practically to eliminate all expensive 132,000-volt oil switches. In case of a fault on the trolley system, the relays will select and the high-speed breakers will disconnect the particular part of the circuit that is in trouble from the rest of the system in one cycle (a twenty-fifth of a second) and before burning or other trouble caused by the short circuit can cause appreciable damage. The locomotives and multiple-unit cars also depend upon the same breakers for protection.

A simple form of catenary structure has been evolved which is adaptable to various conditions of track and degrees of curvature. A new type of insulator was produced to meet the clearance requirements of the Hudson and East river tunnels, and the tunnel conditions also resulted in the development of concentric cables for the transmission of 11,000-volt, single-phase power.

A bold method for effecting inductive co-ordination between power and communication circuits has been put into practice, in which a parallel to the ground or return circuit of the offending line is actually run in the same ducts with the communication circuits.

High-voltage lightning arrestors have been practically eliminated and a method of lightning protection has been developed which serves to dissipate lightning discharges harmlessly. These and many other engineering achievements have come out of the Pennsylvania electrification.

Type of Service Rendered

In the a.c. electrified territory, because of the total density of traffic requiring its fairly definite arrangement, as well as because of the nature of the freight handled, a large portion of which consists of articles or merchandise upon which the delivery time is guaranteed, the freight traffic is almost entirely moved by timed or scheduled trains. There are very few extra freight trains. The number and the time of the scheduled freight trains is arranged from season to season, spring and summer, fall and winter, in such a way as will best serve the traffic it is anticipated will be offered during that season. The different classes of traffic offered are studied and the freight schedules are arranged, so far as possible, to meet the varying requirements of these different freight classifications.

It is apparent that in the electric operation of this arranged traffic, in which the slack times of passenger traffic are filled by freight traffic, the load factors will be better and more nearly uniform, than could be expected with a more haphazard movement.

Facilities Required

When the electrification to Washington is completed it will require approximately 816,000,000 kw. hr. per year (1,094,000,000 hp. hr. per year) to operate the total Pennsylvania a.c. traction territory. This represents an average load of 125,000 hp., the peaks, of course, being considerably in excess of this value. It will include 1,519 miles of track, 41 step-down substations ranging in capacity from 9,000 kva. to 27,000 kva., and seven supply stations ultimately ranging in size up to 320,000 kva., to supply electric current to the transmission circuits. The total substation capacity of the New York-Washington section will be 1,196,500 kva.

The requirements also include from 111 to 118 new electric passenger locomotives, 71 to 88 new electric freight locomotives, 14 to 65 new switcher locomotives and 86 to 114 new multiple-unit passenger cars. Thirty-six existing locomotives will be altered for use in this service.

By the first of April there will be 72 passenger locomotives, hauling trains in the territory between New York and Philadelphia, and to Wilmington and Paoli. There are now 345 multiple-unit cars in use and 40 newly-equipped cars about ready for service.

History and Development

In 1910, the Pennsylvania Railroad electrified its line from Sunnyside Yard, Long Island, through the New York Terminal at Thirty-third street in New York City, to Manhattan Transfer, near Newark, N. J. Trains from the Pennsylvania station connect at Manhattan Transfer with Hudson & Manhattan Railroad trains from downtown New York. The terminal electrification required the building of two single-track tunnels under the Hudson river and also made connections through the four East river single-track tunnels with the Sunnyside yards on Long Island. The electrification was necessitated by the terminal and tunnel requirements. Locomotives receiving 675-volt power from a third rail were used to haul trains to Manhattan Transfer, where the electric locomotives were uncoupled and steam locomotives attached to the train. The change from low-voltage, direct current to high-voltage, alternating current was anticipated at the time the tunnels were built and clearances were provided for that purpose.

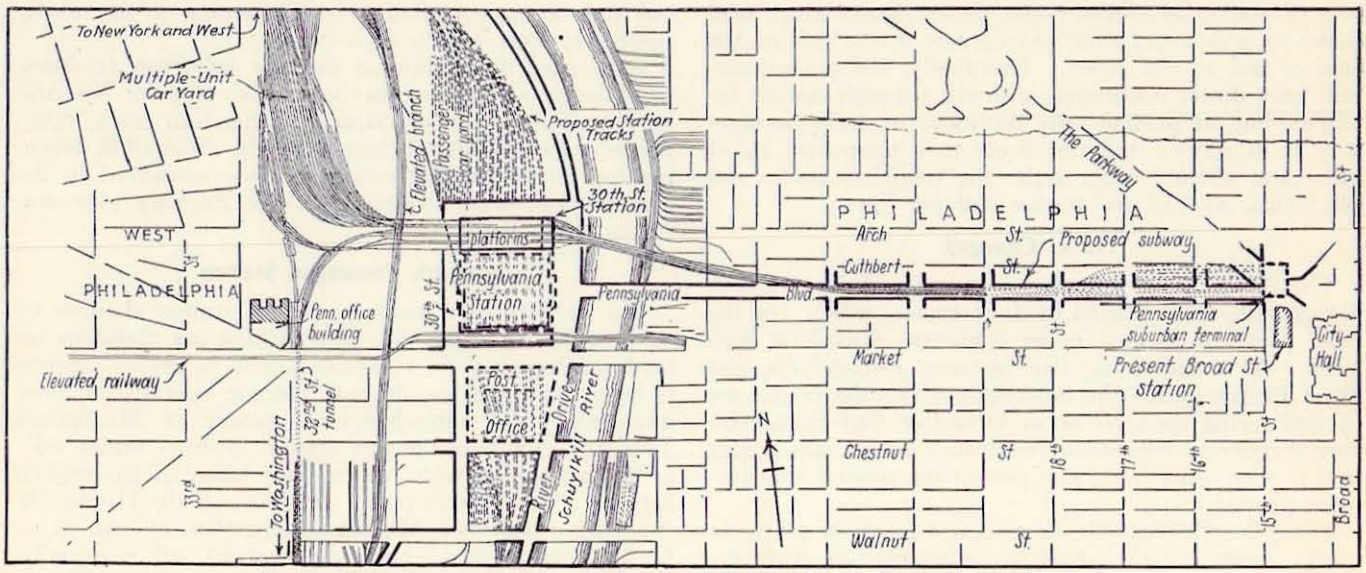
Suburban transportation by means of multiple-unit cars was initiated between Philadelphia and Paoli in 1915, to provide for increasing suburban traffic and the needs of a congested terminal. This was extended to Chestnut Hill in 1918, to White Marsh in 1924, to West Chester and Wilmington in 1928, and to Trenton and Norristown in 1930, which includes all the suburban services in the Philadelphia area.

The present electrification program, including both passenger and freight service, between New York and Washington, D. C., and westward was authorized in 1928. It will connect the previously existing electrified sections and will provide improved and smokeless passenger transportation between these metropolitan districts. It is expected that the costs of operation and maintenance for both passenger and freight service will be reduced more than enough to justify the installation cost. The equipment used has the capacity to haul heavier trains, to make possible faster schedules and greatly to increase track capacity, although no change in schedules has as yet been made.

Electric locomotives now haul trains through Manhattan Transfer without changing locomotives. At present trains are still brought in from West Phiadelphia over the Schuylkill river into the old Broad Street Terminal and out again through West Philadelphia. When the changes now being made in station facilities are completed, through trains will pass through West Philadelphia and a shuttle service will carry passengers between the new passenger station in West Philadelphia and the new underground Broad Street Terminal. Two tracks through the new West Philadelphia passenger station will be put in service on March 12, and use of the old West Philadelphia station will be discontinued.

New Passenger Station Facilities

AS a distinct part of, or in conjunction with, the electrification of the Pennsylvania, there have been a number of changes in passenger station facilities which assume considerable proportions. Among the most important of these are a new electrified suburban terminal in the heart of Philadelphia, almost directly adjacent to the old Broad Street station; a new through and suburban station at Thirtieth street, in West Philadelphia; and new station facilities, under way, at Newark, N. J., which, eventually, will do away with passenger interchange at Manhattan Transfer, located between Newark and New York City. The most important of these are the new station facilities in the Philadelphia area which include the suburban passenger station in the heart of Philadelphia and the new through passenger station in West Philadelphia; these to be in keeping with the importance of the city, and of the railroad to the city.



Sketch of the Present and Proposed Track and Building Layout in the Philadelphia Area

Electrified Terminal in Center of City

The new Broad Street suburban passenger terminal, which accommodates all of the Pennsylvania's suburban service into and out of Philadelphia, involving the movement of more than 300 trains and the handling of 50,000 or more commuters daily, is located immediately north and west of the Pennsylvania's present Broad Street station, directly beneath a new 22-story office building, 397 ft. long by 108 ft. wide, built by the railroad. The station proper, which is completely underground, with direct connection with the office building, the city streets, the city subway system and the old Broad Street station, embodies in its construction and layout the most up-to-date features for this type of rail terminal. The station facilities are confined entirely to a mezzanine floor, 15 ft. below the street level, and to a track level, the platforms of which are about 14 ft. below the mezzanine floor. In area, each of these two levels of station facilities is much larger than that of the office building above.

The mezzanine floor of the terminal is in the form of a general concourse, with waiting rooms, ticket offices, an information desk, a barber shop, telephone and telegraph offices, rest and toilet rooms, and numerous stores and concessions. The track level, on the other hand, is used exclusively for platforms and tracks. At present, this level has four island platforms, each 1,134 ft. long and 24 ft. wide, and 7 stub station tracks. Final plans call for five additional tracks and two additional platforms, which, however, cannot be built until space is made available by the wrecking of certain old existing facilities.

Suburban Station at West Philadelphia

The suburban station in West Philadelphia, known as the Thirtieth Street station, is located practically due west of the Broad Street suburban station, and, eventually, will become an integral part of the new through passenger station which is being constructed by the road immediately adjacent, to the south. Essentially, the suburban unit was opened to accommodate passengers who desire to use the electrified suburban trains passing through West Philadelphia, but later, when the new through passenger station is completed, it will serve not only that purpose, but also as the suburban unit of the new through passenger station. As previously stated, two through tracks and one platform through the new passenger station area, and a small section of the passenger station itself will be placed in service on March 12.

At that time, the station facilities at West Philadelphia will become a transfer point for passengers from through trains desiring to go into the center of the city, and, likewise, for passengers from the center of the city, who desire to make connection with through trains which do not come into the old Broad Street station. Elevators, escalators, stairs and easy ramps are being provided between the through station level and the high suburban station level to afford greatest convenience to passengers.

The suburban station unit itself consists essentially of three intermediate platforms, about 1,100 ft. long, and six station tracks. The platforms, which are covered by an attractive glazed cement tile shed, with an umbrella-shaped top directly over each platform, each have four

Looking Through the Track and Platform Level of the Broad Street Suburban Terminal

sets of stairs, an elevator and an escalator, which lead down to wide mezzanine passageway at the end of the station and to the street. Eventually, the passageway will have direct connection with the through station facilities, but, at present only the more westerly passageway is in service and this leads to a temporary ticket office and waiting room under the suburban tracks and platforms, west of the station building line.

Track Changes

The Broad Street suburban terminal and the Thirtieth Street station are joined by four tracks, which, for the most part, are located in an open cut, walled on both sides. At the dividing line between Philadelphia and West Philadelphia—the Schuylkill river—the tracks are carried across the river on an attractive four-track reinforced concrete, sandstone-faced arch bridge, this bridge having been constructed as a part of the general improvement project.

From the Thirtieth Street station, two of the platform tracks swing to the south to a connection with the through main line and branch lines to the south, while the other four tracks swing to the north and have connection with the main line and branch lines to the east and west. The tracks of the new through station will pass beneath and at right angles to the suburban station tracks, and will be so connected with the present main line that all movement through the station to the north, south and west will be continuous.

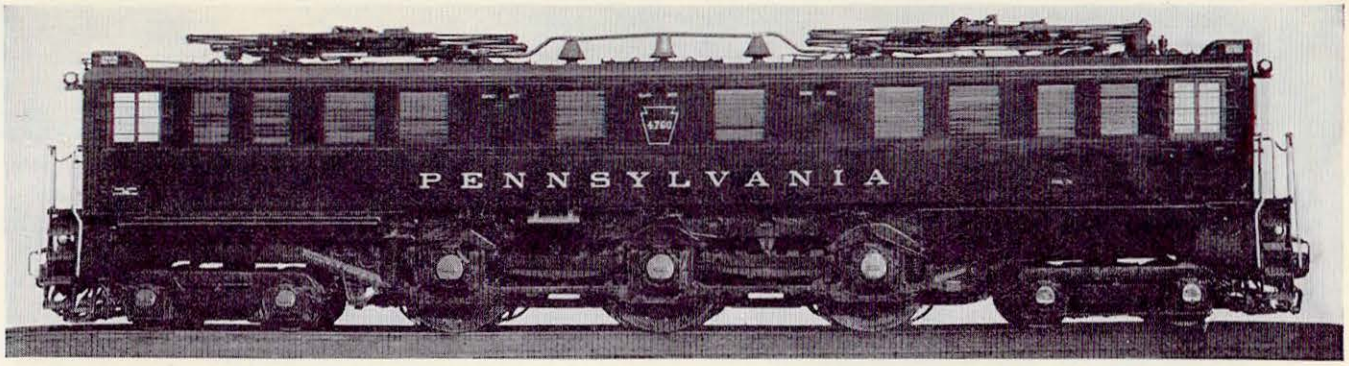
A detailed description of the new suburban facilities at Philadelphia appeared in the *Railway Age* for November 15, 1930, and a description of the four-track, reinforced concrete arch bridge over the Schuylkill river, together with the interesting methods employed in its construction, were described in the *Railway Age* for December 7, 1929.

Newark Passenger Station

The only further major passenger station changes to be brought about by the electrification are those to be made at Newark, N. J., where a new passenger station is being built. Since through electric operation makes unnecessary the interchange of power at Manhattan Transfer, and since the new station facilities under way at Newark will provide for the interchange of passengers between Pennsylvania trains and those of the Hudson & Manhattan Railroad, Manhattan Transfer, at least in so far as Pennsylvania service is concerned, will eventually pass into history.

Other changes in connection with passenger service have been of relatively little importance, involving only minor track changes at Wilmington, Del., and Paoli, Pa., to permit the quick interchange of steam and electric power.

Looking Through the Track and Platform Level of the Thirtieth Street Station



Class P5a Heavy-Duty Passenger Locomotive

Locomotives Develop 1,250 Horse-Power Per Axle

Motors placed between axles provide maximum tractive forces permitted by weight on drivers

LOCOMOTIVE requirements of the Pennsylvania electrification are supplied by four types of motive power as follows: The class P5 locomotive for heavy duty passenger service, having a 2-C-2 or 4-6-4 wheel arrangement; the class O1 locomotive for light duty passenger service with a 2-B-2 or 4-4-4 wheel arrangement; the class L6 locomotive for freight service having a 1-D-1 or 2-8-2 wheel arrangement, and the class B-1 switching locomotive with an O-C-O or O-6-O wheel arrangement.

The axles of the P5 and O1 locomotives are driven by twin motors, through quills. Each motor is rated at 625 hp. continuous at the driver rim, thus providing 1250 hp. per axle. The performance characteristic of the two types of passenger locomotives are the same so that they may be operated separately or in any desired combination; thus with an O1 locomotive, 2,500 hp. is available with two pairs of drivers; with the P5 locomotive, 3,750 hp. is available with three pairs of drivers; with two O1 locomotives, 5,000 hp. is available with four pairs of drivers; with an O1 and a P5 locomotive the five drivers provide 6,250 hp., and with two P5 locomotives, 7,500 hp. is available.

The axles of the L6 freight locomotive are each driven by one motor which is electrically similar to one-half of the twin motors used for passenger locomotives. A nose suspension of the motors and flexible gears are used in place of the quill drive.

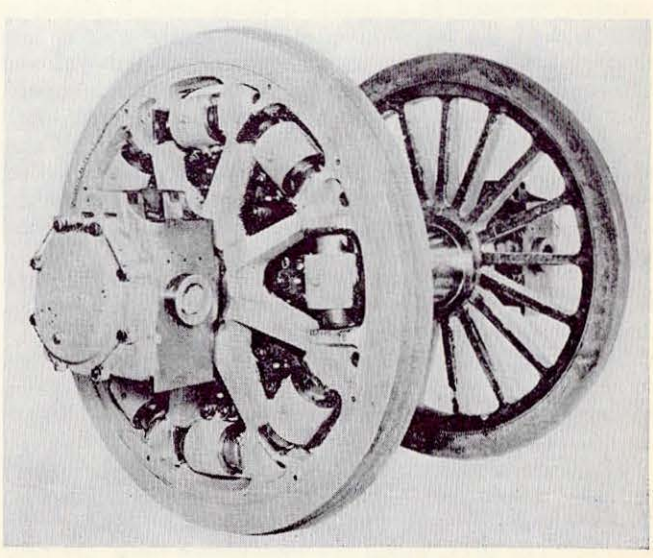
The class B1 switcher was developed some years ago, has been built in quantities for Pennsylvania service and is giving satisfactory performance in operation on alternating current on the Long Island and the Pennsylvania and with modified control when operating on direct current on the Pennsylvania. Similar locomotives with slight modifications will be used on alternating current for extensions to switching service.

Influence of Motor Design

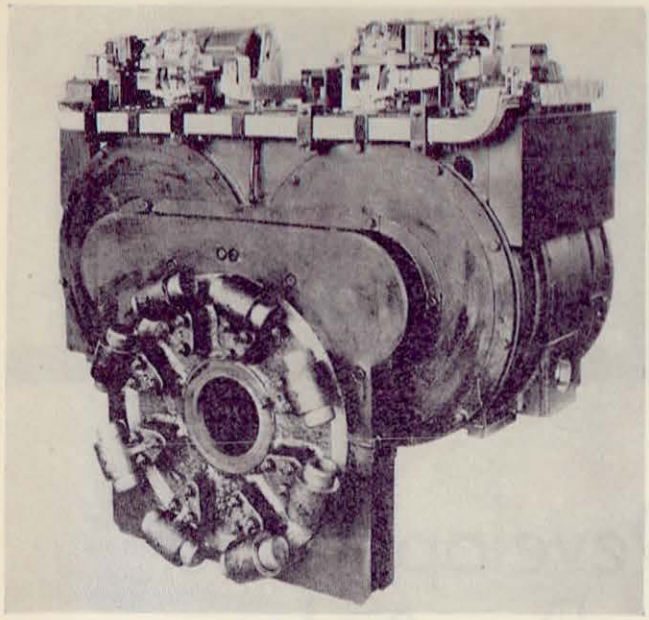
The passenger and freight locomotives now in service and under construction were made possible by new types of motor, the design of which was worked out jointly by the electrical manufacturing companies to meet the demands of the Pennsylvania Railroad.

Locomotives of the L5 type developed previously for Pennsylvania service were designed for use either with passenger or freight trains with a modification of gear ratios. They were also adaptable for use on either alternating or, with modified control, on direct current. Jack shafts and side rods were employed as a means of transferring the motor horsepower to the driving wheels. The available motors did not permit placing between the driving wheels sufficient a.c. motor capacity to handle the tractive forces which the weights on drivers permitted. The new motors now provide between driving wheels sufficient motor capacity to furnish tractive effort to utilize the weight per pair of drivers permitted by the heavy track construction on the Pennsylvania main lines. Jack shafts and side rods are thus no longer necessary.

With the motor limitations removed, it was decided after study and review of steam locomotive practice to



A Pair of Driving Wheels with Quill and Bearings



Twin Motor and Quill

design an electric passenger locomotive with a weight per pair of drivers of about 75,000 lb. and a total weight of locomotive of about 375,000 lb. These locomotives were designed to duplicate or better the performance of steam locomotives which were handling trains satisactorily.

To permit increased operating speeds, if found desirable in the future, it was decided that a maximum operating speed of 90 miles should be selected for the passenger motive power. The L6 freight locomotive is geared for 54 miles an hour.

Mechanical Construction

The two passenger locomotives and the freight locomotives are so designed that the maximum number of parts are interchangeable and the general designs are similar. The following description of the construction of the P5 heavy-duty passenger locomotive therefore applies generally to all three types of locomotives.

The P5 locomotive with its 2-C-2 wheel arrangement has a rigid frame between couplers. The cab is mounted directly on the main frame. There is a four-wheel truck at each end and three pairs of driving wheels in the rigid wheel base. A standard A. R. A. swivel shank coupler, mounted in a standard draft gear, is placed at each end of the locomotive, and the entire coupler and draft gear assembly is so designed that removal and replacement is made from the front of the bumpers. The draft gears are held in place by square pins dropped into position from the top of the frame casting. Water and fuel tanks and main air reservoirs are embodied in, and cast with, the main frame. The engine truck frames, as well as the main frame, are of the integral cast steel type.

The weight of the locomotive is distributed to the wheels by an equalizing system consisting of main springs and equalizers providing a stable system in lateral as well as longitudinal planes. The brake system consists of practically three sets of brakes, each engine truck having its own set and the drivers the third. Clasp brakes are used on the drivers.

The wheel centers are of cast steel, having eight spokes provided with pads for receiving the torque of the motors as transmitted through the gears and quills to the driving wheels. The tires, which are four inches thick, are held on by shrinkage and retaining rings. The outside drivers are flanged and the middle driver is plain. There are three twin armature traction motors on the locomotive, supported rigidly on the crossties of the main frame.

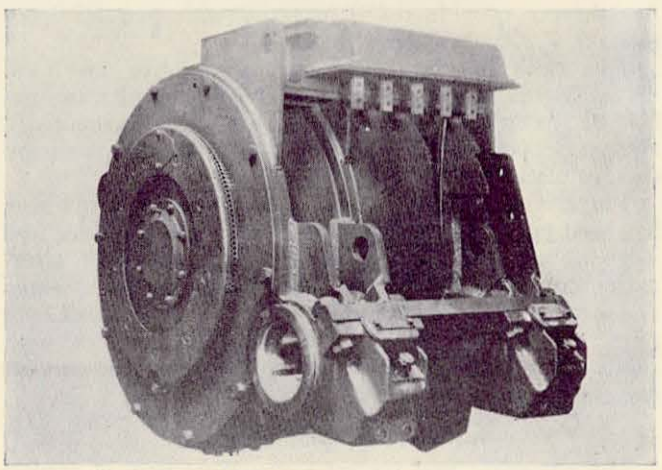
The traction motors transmit power to the drivers through the quill type cup drive, the driving member being on one end of the quill only. In the L6 freight locomotive, single motors are mounted in a frame suitable for axle mounting, and drive the wheels through conventional gear arrangements. Anti-friction roller bearings are used on all journals and also for motor armature bearings.

The quill consists of a hollow cylindrical forging 15 in. in diameter at the quill bearings, with the gear mounted on one end. The driving axle is inside the quill; there is 1¾ in. radial clearance between the axle and the inside of the quill to permit freedom of movement between the axle and motor frame while maintaining accurate mesh of the gears and pinions. The quills are secured to the main motors by bearing caps on the main motor frames which, in turn, are attached to the main frame by means of a three-point support. All the movement between the driving wheels and the quill is taken up by sliding contact between the quill spring caps and the driver spokes. The quill arms, with their spring sockets are attached to the gear center and make contact between the driver spokes. Each armature has a pinion shrunk on one end of the shaft which engages the gear on the quill, and the power is thus transmitted from the [illegible] to the drivers.

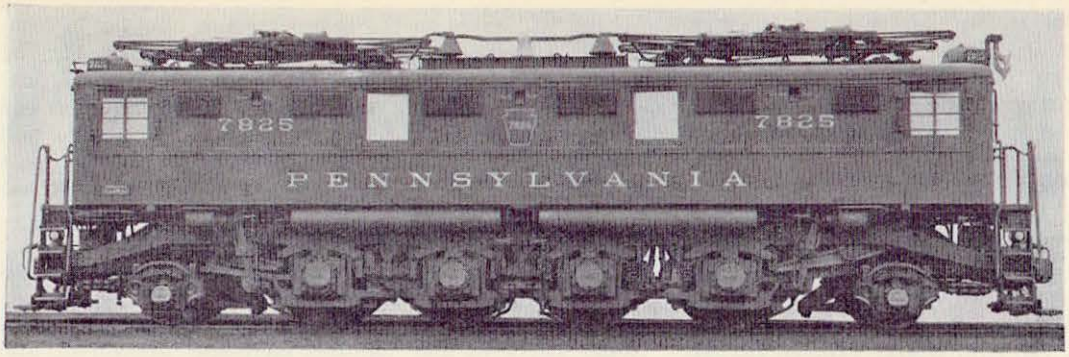
[illegible]ne gearing is held in mesh to proper centers by the [illegible]uill bearings. The upper half of the bearing fits into the main motor frame, and has a brass with a flanged end; it is held in place by the lower brass which is keyed into the cap. The bearing is oil-lubricated. The cap is held in place by four 1½ in. bolts which are secured with nuts and lock washers. The gearing is enclosed in a gear case and is lubricated with grease, suitable openings being provided for refilling.

Cab and Apparatus Deck

The cabs are built up of sheet plates and structural shapes. A separate deck for mounting the electrical equipment is so designed that it can be handled as a unit and placed in position on the main frame by a crane. Aisles on each side of the deck facilitate inspection and maintenance. The apparatus deck or unit carries the main control groups, air compressor, miscellaneous items, main wiring and most of the control wiring. The foundation for this unit is a structural framework upon



Freight Locomotive Motor



Class L-6 Experimental Freight Locomotive

which the electrical equipment is assembled and wired up; the completed unit is then ready for mounting on the chassis.

The cab unit forms a weatherproof housing for the locomotive crew and apparatus. It is sufficiently wider than the apparatus deck to permit an aisle on either side and enough longer to furnish space for the heating boiler at one end, the main transformer at the other, and an operating compartment at either end. The cab structure, in addition to forming a housing, contains the master controllers, an engineer's brake valve, the lighting and its wiring, some of the control wiring, the bells, whistles, headlights, sanders and pantographs, as well as the louvre structure for admitting ventilating air to the motor and transformer blowers. It is assembled as a unit, wired and equipped with apparatus and mounted as a housing on the chassis unit after the deck unit has been installed.

Electrical Equipment

The pantograph or current collectors are mounted on the roof, one near each end. In operation, current is collected from the trolley wire by one of two pantographs and is thence conducted through the high voltage or primary winding of the main transformer to the rail or ground. The two pantographs are connected by a high-voltage bus and, in case of damage to either pantograph, the bus can be divided at the center so that the damaged pantograph can be disconnected and the transformer supplied by the remaining one.

Current is taken from the low-voltage or secondary winding of the main transformer to the traction motors. There are a number of taps on the secondary of the transformer and the voltage to the motors can be controlled by changing the taps to which the motor leads are connected. This is accomplished by air-operated switches controlled electrically from the operating cab. When the locomotive is moving slowly the voltage applied to the motors is low. The counter-electromotive force generated by the motors is also low and the amount of current is relatively high. As the locomotive speed increases the amount of current flowing through the motor winding decreases and the voltage is again increased by the operator to provide the necessary power.

The secondary voltages from the transformers used for motor operation provide voltages varying from 224 to 960. The motors are connected in two groups of three in series, the 1, 2 and 3 motors being in one group and the 4, 5 and 6 in the other.

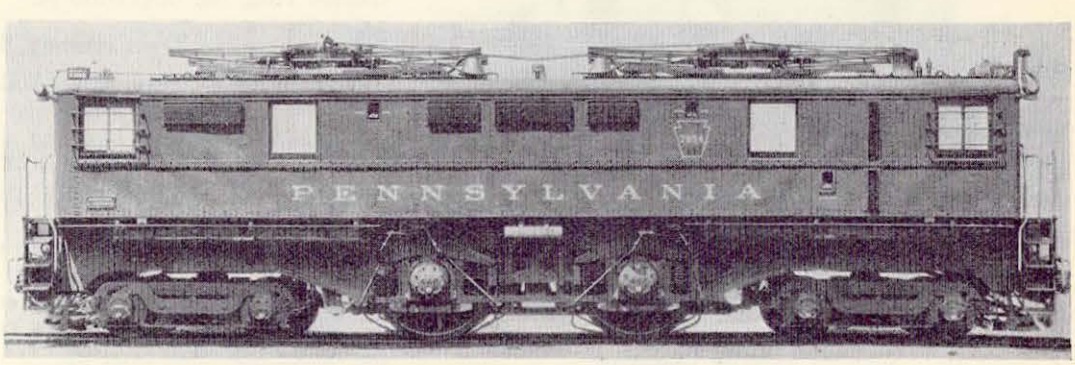
Auxiliary and Control Equipment

Only low-voltage battery current is used in the controllers in the engineman's cab and all high-voltage equipment and circuits in the locomotive are enclosed. The equipment compartment contains the high-voltage apparatus which is protected on each aisle side by screens and covers which are kept in place whenever the pantographs are up. Relay and control cabinets are built into the equipment compartment with hinged doors.

Motor-driven blowers for cooling the motors and the transformers are operated from the main transformer on a 384-volt tap. Single-phase motors for this purpose are equipped with a starting winding which is cut out by a relay that functions when air pressure on the blower discharge has risen to a pre-determined value.

The compressor motor, the cab heaters and the blower motor for the oil-fired train-heating boiler are operated from a 224-volt motor tap. The operation of the compressor motor is controlled by the air pressure in the main reservoir; the electrical cab heaters are manually operated, and the air pressure to the boiler burner is controlled by the steam pressure through a damper in the air duct. Air pressure at 70 lb. per square inch for the operation of electro-pneumatic switches is supplied from an auxiliary reservoir which is fed from the main reservoir through a reducing value.

Direct current power at 32-volts for the operation of control circuits and emergency lighting is supplied by a generator operated by the same motor as the transformer blower and operating in conjunction with a storage battery. When the pantograph is up the lights are supplied by a small transformer, the primary of which is



Class O-1 Experimental Locomotive for Light Duty Passenger Service

connected to a 144-volt tap on the main transformer. When the pantographs are down, a relay disconnects the lighting circuits from the lighting transformer and connects them to the storage battery. The relay operation is reversed when the locomotive is again energized.

Protective Devices

Faults or grounds in the secondary wiring to the unit switches and in the transformer windings are detected by a relay which selects the defective circuit and opens the controlling switches, or if this does not clear the trouble, or if the fault is in the transformer itself, closes a switch which grounds the pantograph, causing the adjacent substation breakers to open. After the line is de-energized, the relay lowers the pantograph.

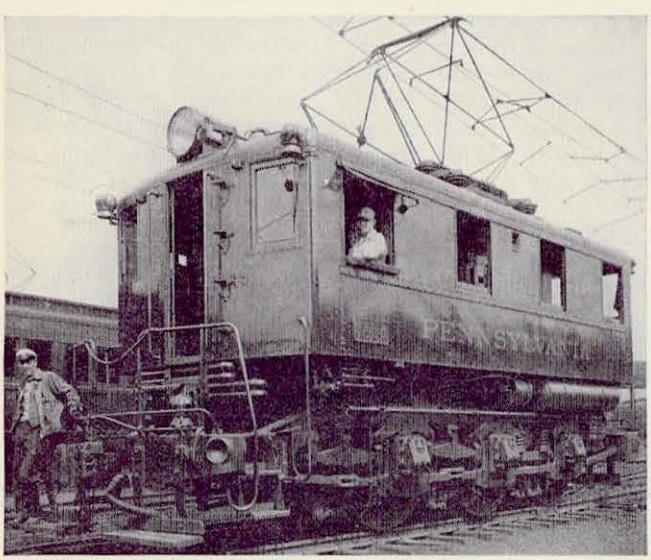
Overload of a motor circuit causes that circuit to be opened; this is indicated to the engineman by the lighting of a signal lamp and by the operation of an alarm buzzer in the cab.

Differential voltage relays check the relative values of voltages across the motors on different wheels, and should the speed of one wheel rise as compared with either of the others due to wheel slippage, the relays will serve to disconnect the motors and prevent overspeeding. The engineman is also apprised of this action in advance by a lamp and buzzer, so that he can normally anticipate the operation of the slip relay by shutting part way off until the wheels cease slipping.

Interchangeable Parts

To facilitate and simplify maintenance, special attention has been given to interchangeability of parts. Any unit or part, armature, motor, brush holder, transformer or control unit on any P5 locomotive will fit into and function properly in any other P5 locomotive assembly, regardless of the manufacture of other parts in that assembly. Close co-ordination between the manufacturers and the railroad in the development of designs, in checking and approval of drawings, and in other details, was necessary to attain this result.

Each complete locomotive assembly consists of three units: A chassis unit, a deck unit and a cab unit. Each of these three units may be assembled independently of the others and the completed units may then be assembled into a complete locomotive. Parts, such as a pair of drivers, with the drive and motors, a truck, a transformer, etc., may be removed and replaced with a minimum of disturbance to the rest of the locomotive.



Class B-1 Switching Locomotive

Electrical parts on the passenger and the freight locomotives are interchangeable to a remarkable extent. The unit switches, reversers, air compressors and motors, pantographs, motor-driven blowers for motor ventilation and relay systems are identical. The preventive coils and transformers are identical on the O1 and the L6 locomotives, but on the P5 locomotive they are larger because of the greater capacity required.

Although the assembled motors on the O1 and P5 locomotives are of the twin-armature, frame-supported type and those on the L6 locomotive are of the conventional single-armature, axle-supported type, the individual parts of the motors, including armatures and stators, are identical except for the frame, end housings and pinion end bearings. The stators may be pressed into or out of either type of frame.

The mechanical parts of the O1 and P5 locomotives are interchangeable to a large extent; the driving wheel assemblies, including the bearings, are the same, truck assemblies are the same, and many parts of the spring and equalizing rigging as well as many parts of the brake rigging are identical. In addition, many of the parts used to make up the apparatus deck and cab structure are the same.

Every effort was made to insure that each piece of apparatus is readily accessible for inspection and readily removable for repair, so that a locomotive may have a defective piece of apparatus replaced and be returned to service in the minimum amount of time. For this purpose hatches are provided in the roof of all three classes of locomotives. These are readily removable and are so arranged that any piece of apparatus inside the cab may be taken out through one of the hatches for repair or replacement.

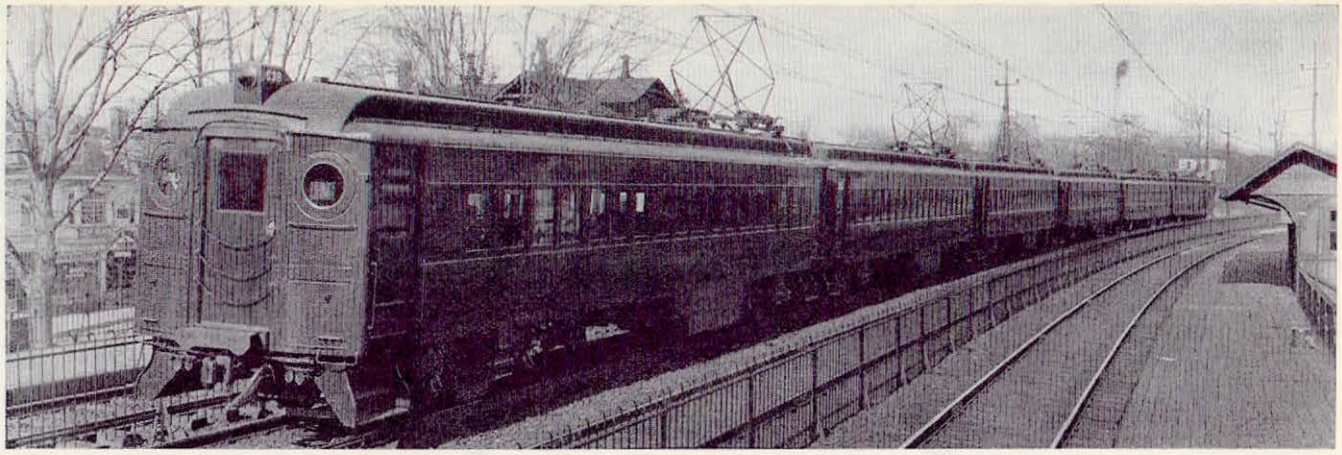
Principal Weights and Dimensions on P5 Locomotives

Diameter of driving wheels	72 in.
No. of driving axles	3
Diameter of truck wheels	36 in.
No. of truck axles	4
Length of wheelbase (total)	49 ft., 10 in.
Length of wheelbase (rigid)	20 ft.
Width of locomotive (over-all)	10 ft., 6 in
Length of locomotive (over-all)	62 ft., 8 in.
Height to top of pantograph (locked down)	15 ft., 0 in.
Weight on drivers	225,000 lb.
Weight per driving axle	75,000 lb.
Total weight	375,000 lb.
Horsepower continuous	3,750

A complete driving wheel assembly, including the motors, may be dropped from the frame in the repair shop and replaced in a relatively short time, thus making all electrical parts of the locomotive readily accessible and renewable either from above or below. In addition to this, each piece of apparatus inside the cab may be inspected from the interior of the cab, and the commutators and brushholders of the main motors may be inspected from the inspection pit.

Train Heating Boilers

The oil-fired train-heating boilers are located on the number one end of the locomotive. They are of the vertical tubular type and have an evaporating capacity of 4,500 lb. of water per hour at 200 lb. pressure. Water level and steam pressure are maintained automatically, the high-low flame method of pressure control being used. Adequate safeguards are provided to cut off the oil supply in case of low water or other emergencies. Air for combustion is furnished under pressure by a separate motor-driven fan. Control is entirely automatic after the boiler has been fired up.



Multiple-Unit Train at Narberth on the Philadelphia-Paoli Line

New Car Equipment Permits Use of Trailers On Same Schedules

IN 1915 the Pennsylvania suburban service between Paoli, Pa., and Philadelphia, Pa., was electrified, the rolling stock consisting entirely of multiple unit equipment with every car a motor car. This service was gradually extended to include all the suburban lines in the Philadelphia district, a total of 345 cars being equipped with electric motive power for this purpose.

One truck on each car is equipped with two motors. The motors are connected permanently in series at starting, and up to about 15 m.p.h. they operate as repulsion motors. At speeds above 15 m.p.h. they operate doubly-fed; current is supplied directly from the main transformer and also indirectly by transformer action of the auxiliary field. Each motor has a continuous rating of 205 hp., making a total of 410 hp. per car. The normal rate of acceleration is about one mile per hour per second up to 30 m.p.h., with a balancing speed of 60 m.p.h.

Each motor drives one axle through flexible gears having a 24-55 ratio. The transformer is of the two-circuit, air-blast type, and is suspended from the center sill of the car close to the motor truck.

The master controllers are of the single-handle type with the dead-man's emergency trip, and automatic or current controlled acceleration is used. Control energy is obtained from a motor-generator set operating in parallel with a battery. The motor is of the split-phase induction type. Nine control wires, including the battery plus and return wires, are required between cars for motor control and seven wires for the control of the electric braking apparatus. A single-phase series commutator motor drives the fan for ventilating the transformers and the motors. The air compressor is driven by another series commutating type motor, the operation of which is controlled automatically by main reservoir pressure. Two hundred of the 345 cars are now equipped with continuous type cab signals. One cab signal-equipped car is required at the head of the train when operating in cab signal territory.

Additional cars were required for suburban service. Forty of these have a new type of equipment and will be used interchangeably with existing multiple-unit equipment in electrified territory.

New Equipment

Improved motors, similar to those developed for locomotives and not doubly-fed, have opened up new possibilities in multiple-unit car equipment design. The new cars are arranged in units of two cars, a motor car and trailer, semi-permanently connected with a control position in the outer end of each car.

Two motors, with a continuous rating of 370 hp. each, drive the axles on one truck of the motor car. As in the case of the older equipment, the motors are nose-suspended and drive through flexible gears. These 370-hp. motors weigh somewhat less than the older 205 hp. motors. The transformers for the new cars are not as heavy as two of the older type and the new motor cars will weigh approximately the same as the older cars; the trailers are considerably lighter. The characteristics of the two types of motors are the same and the 740-hp. truck of the two-car units will provide the same speeds and rates of acceleration as the 410-hp. truck of the older motor cars. This permits operating the two types of equipment together in any desired combination.

The new motors require considerably increased ventilation; twice as much as the doubly-fed motors. This made it necessary to handle the air more efficiently since no additional space was available. Air is taken in through louvres in the side sheets on each side of the car and is carried through ducts to the fan housing. From the fan, part goes into the center sill and thence to the motors through canvas ducts and the remainder goes to the transformer through a filter box, where cloth bags are provided to remove dirt and snow. The motor insulation is such that it is not necessary to filter their cooling air.

About 18-hp. is required to supply ventilation and to drive a small generator on the same shaft. The generator supplies auxiliary power in conjunction with a storage battery. The master controller uses battery voltage

while the lights and cab signals are supplied with 32-volts through a carbon pile regulator. This eliminates an extra battery and battery-charging equipment used on the older type of cars to supply 32-volt power for cab signals.

In the older equipments, auxiliary circuits are controlled directly by switches in a cabinet in the vestibule. On the newer equipments, these circuits are controlled remotely. Power circuits employing heavy cables and relatively high voltages are now removed from the vestibule cabinets and are handled by a remote-controlled switch group under the car. This change has permitted the use of a much smaller cabinet.

The new motors will undoubtedly show a greatly increased brush and commutator life and the new equipments are simpler, lighter in weight, and lower in cost than the old.

Much credit is due both the manufacturer and the railroad for bringing about these changes and adapting them to railroad service.

Locating and Erecting Catenary Supporting Structures

WITH electrification authorized, one of the first problems was to look to the extensive roadway installations and changes necessary to such a system. Essentially, this work involved the location and erection of the catenary bridges, with the extended surveys and field checking which this entailed; the disposition of existing overhead communication lines, either underground or in aerial cables to preclude interference with the new overhead structures; and the alteration, where necessary, of track grades and alinement, and of existing overhead bridges and tunnels, to permit pantograph operation and to secure the most favorable clearances possible for the movement of high freight loads.

Careful Track Surveys Necessary

Following carefully prepared working schedules, the roadway work in connection with each section of the electrification progressed with a high degree of smoothness and co-ordination with the other phases of the electrification work. One of the first and most important steps in the roadway work was to secure accurate information concerning the track layout within the section to be electrified. This was done by an engineering field party, which made a continuous track survey over the section involved, establishing 100-ft. stations on the rail. The detailed information secured in this survey was incorporated on continuous track plans, 100 ft. to the inch, using the I. C. C. valuation plans of the territory in question as an outline. This resulted in a new set of plans, accurate in every detail according to stationing adopted specifically for electrification, and with only that data necessary to the electrification work. Printed tabulations were prepared giving the elevation of the top of rail of the measured track, this information having been secured by a special set of levels run in the field for this purpose.

When prepared, the track plans were turned over to the designing department for the preliminary location of the catenary bridges. The bridge spacing was established on the basis of balanced half spans, an arrangement in which there is an equal half span of catenary construction on each side of each bridge. This not only put balanced loads on the poles and improved the general appearance of the pole layout, but also greatly simplified the design of the catenary construction. It was often necessary to relocate the poles because of existing structure or foundation conditions.

The normal bridge spacing for tangent track was figured at 270 ft., but actual installation varied each way from this distance as conditions required, the span decreasing with an increase in the degree of curves. Variations in bridge spacing were made in increments of 15 ft. in order to be able to standardize catenary hanger lengths as far as possible.

Following the preliminary location of the cross bridges on the plans, the proposed locations were carefully checked in the field to determine the feasibility of installing the foundations and poles in the locations selected. As might be expected, this field check resulted in the relocation of many bridges. Where the sites originally proposed could not be adopted, the field force recommended substitute sites and, taking these recommendations into consideration, the span lengths were again balanced and the new locations were checked in the field. This procedure was followed until the plan spacing coincided with the best bridge spacing possible in the field.

Erection Work Carefully Scheduled

With the bridge sites finally decided upon, cross levels of the right-of-way were taken at each bridge location, and, at the same time, an accurate chord survey was made of the tracks to be electrified, using the center lines of the bridge sites as chord points. A cross section drawing was then prepared for each bridge location to show the type of bridge to be erected, the specific type of foundation, and the position of all guys and guy anchors.

These cross sections were then taken into the field where they were checked to insure that the pole installations could be made as shown without encountering difficulties which could not be met satisfactorily. Any changes found necessary by the field check were referred to the designing department. Corrections were then made, and the plans issued for foundation construction. At about this same time, the poles were ordered, along with a considerable part of the necessary pole fittings, so that erection could be begun without delay as soon as the foundations were completed.

As the bridge foundation plans were issued, the field engineering party staked out the foundations and guy anchor locations on the ground, and then the construction forces began excavation and actual construction work. If any additional changes in layout or design were found necessary during excavation, these were re-

ported promptly to the designing department so that the plans could be corrected accordingly.

When the foundations and anchors had been installed, the cross section drawings corresponding with the final layout were again issued by the designing department, this time showing all necessary data for the erection of the steel. While this latter work progressed, the plans were made complete for the catenary, guys, cross catenary, trolley insulator assemblies, crossarms and transmission insulators, and were then turned over to the construction forces for erection.

Poles and Cross Bridges

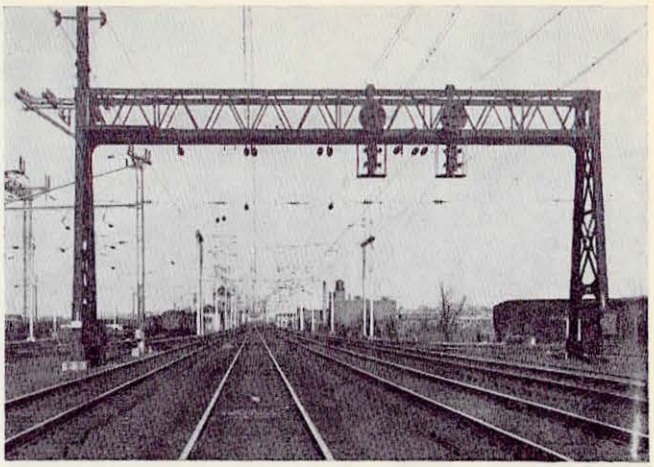
The catenary supporting cross bridges employed in the electrification are essentially of two types, the cross catenary type and the beam type, although special construction was used at a number of points, especially where signals were to be supported on the bridges. Illustrations of cross catenary and beam type bridges are shown in the section, "Transmission, Substations and Catenary System." The signal bridges were usually of the bent or anchor type with a box truss cross member, or of the beam type with a deep channel cross beam to afford the increased stiffness and load carrying capacity required.

The cross catenary type of bridge consists essentially of two guyed side poles with a cross catenary between them, which, in turn, supports the longitudinal catenary and the overhead electrical trolley wiring. This type of bridge, both because of its relative economy of construction and the increased visibility which it affords enginemen, was used wherever possible.

The beam type bridge, which consists essentially of poles similar to those used in the cross catenary bridges, with a suitable cross beam having sag braces extending to it from the poles, is the next most common type of cross bridge, and was resorted to mainly where restricted right-of-way made it impossible to use guys. This type bridge calls for somewhat larger foundations than those required for the cross catenary bridge.

The cross catenary bridge is adapted for spans up to eight tracks in width, while the beam bridge spans have been confined largely to span lengths sufficient to cross six tracks. However, both types of bridges are suited to multiple-span construction, which is usually necessary where there are more than six or eight tracks.

The poles of the bridge construction, which were made to carry the high tension transmission lines in connection with electrification as well as the catenary construction, are of several different types, but, in all but the latest work the steel H-section, or some modification of it, has been used almost exclusively. Tubular poles are used in the electrified sections extending from Philadelphia to Paoli, Wilmington and Chestnut Hill, these poles being made up of sections of different sizes of pipe, swedged together and delivered to the right-of-way as complete units.



Anchor Type Signal Bridge

The H-section poles, which were used largely in the later work, are of the Carnegie and Bethlehem types. Simple H-sections, approximately 14 in. square and weighing 84 lb. per foot, were used mainly in the cross catenary bridges, although heavier sections, weighing up to 103 lb. per foot and more, were used where special conditions required.

Reinforced H-sections were used largely in the beam type bridges to secure increased stiffness with minimum increase in size, these sections consisting essentially of the standard H-section with continuous angles riveted to its four flanges. Some box section poles were used, especially where great height or torsional stresses were encountered. The different poles used have a wide range of height, but generally it varies between 70 and 110 ft. A number of the poles are from 120 to 130 ft. high, and a few are as high as 170 ft.

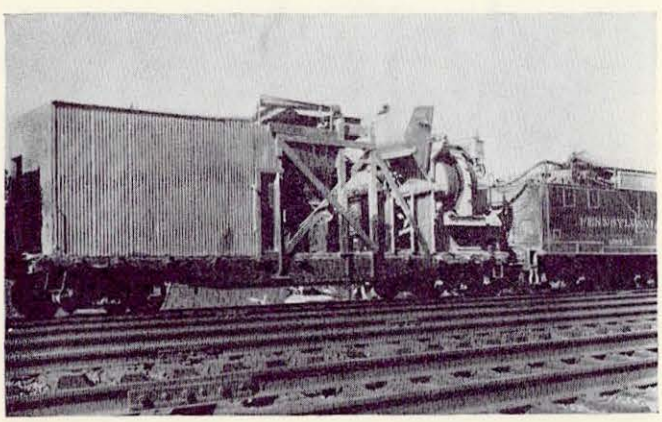
All of the poles were delivered to the right-of-way with one shop coat of red lead. After erection they were all given two additional brush coats. In the earlier work, the field coats were of a lead base paint, with black as the final coat, but in the work of the last two years, including that between Trenton and New York, both of the field coats have been of aluminum paint.

Concrete Trains Pour Roadway Concrete

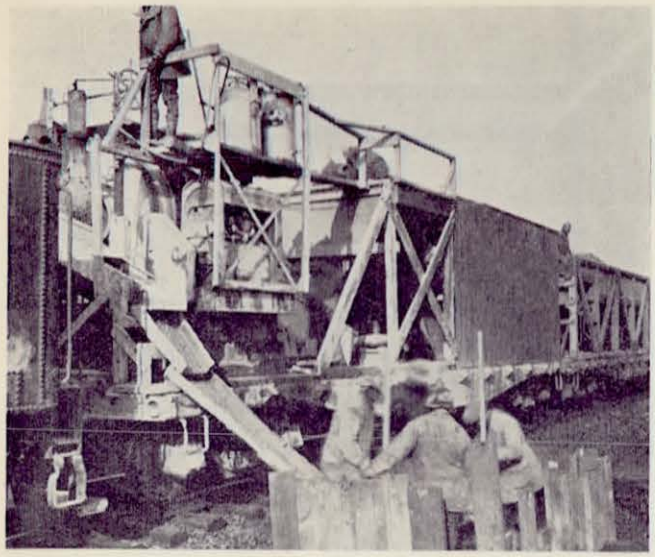
For the construction of the pole footings and guy anchors the Pennsylvania developed a concrete train equipped for 100 per cent mechanical handling and mixing of materials; during the later sections of the work, there were five of these trains in service.

The concrete trains, which are still kept intact for future work, consist of two or three bin cars for carrying the concrete aggregates; a mixer car, where the concrete is prepared; an old engine tank for the water supply; and a cement car, which carries, in bulk, the supply of cement. These cars are coupled together in the order named, with the bin cars at the rear of the train, and are pulled over the road as a work train.

The bin cars are flat cars on which have been mounted two multiple-hopper-bottom storage bins of heavy timber construction, lined with sheet metal. The bins, one of which is about twice the capacity of the other and used for the stone, are set well above the platform of the car and have clamshell-type gates along the bottom, there



The Track Side of the Mixer Car—Note Bulk Cement Delivery Line Passing Back Over the Auxiliary Engine Tank



Pouring a Pole Footing Direct from the Mixer Car of the Concrete Train

being nine such gates on each car, six from the stone bin and three from the sand bin. The gates, which are operated by offset hand levers on both sides of the car, discharge directly onto a power-operated continuous belt conveyor, 16 in. wide, which extends lengthwise of the car. At the forward end of the car the conveyor is inclined upward and extended slightly so that it can discharge the stone or sand directly into a receiving hopper at the rear end of the conveyor of the adjacent bin car, or, in the case of the lead bin car, into a receiving hopper serving a conveyor on the mixing car.

The mixing car, which is also a flat car, is fitted with a gasoline engine-operated concrete mixer, suitable batching equipment, and an elevating-type belt conveyor, housed in, which deposits the aggregates into a two-compartment hopper directly above the skip of the concrete mixer. The mixer, which is of ¾ yd. capacity, is mounted at the forward end of the car, with its drum set at right angles to the center line of the car. In this position, the concrete is discharged forward of the car and into a two-way steel hopper, from which it can be drawn off on either side.

All of the materials entering into the concrete are batched to secure positive control of the quality of the concrete, a two-compartment batcher, equipped with scales, being used to proportion the stone, sand and cement, which are subsequently discharged directly into the elevating skip of the mixer. The water for the mix is supplied from a measuring tank above the mixer, which, itself, is refilled from the auxiliary engine tank supply by a small centrifugal pump, direct-connected to the engine of the mixer. The cement, which is carried along in bulk in a standard steel box car, is picked up in the car by what is known as a portable cement pump or unloader, which, through screw action, forces the cement through a three-inch pipe leading directly to an enclosed cement bin above the mixer.

With a crew of approximately 12 men, including a foreman and a mechanic, and material storage capacity sufficient to make from 105 to 120 cu. yd. of concrete, each concrete train was moved over the road, pouring pole foundations and guy anchors, using metal chutes to bridge the space between the concrete hopper of the mixing car and the forms. Equipped with floodlight, night operation was carried on as readily as day operation, and, fitted with steam pipes for warming the aggregates and water, and a heating torch discharging directly into the mixer, operations were carried on as satisfactorily during the winter months as during the summer.

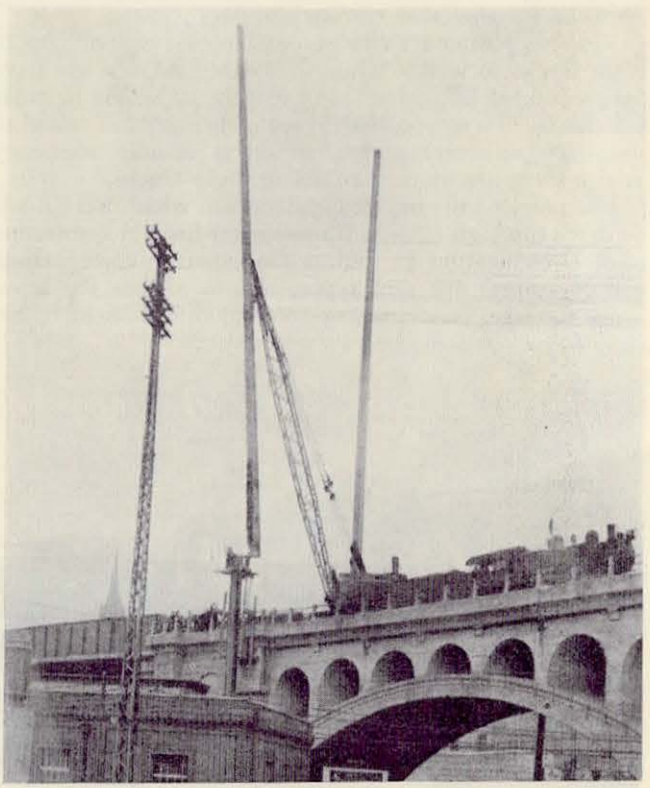
Loading of the aggregate cars of the trains was done by special loading facilities at points along the line. At all of these points a track hopper and power-operated elevating equipment was placed, so that the aggregates, delivered in hopper-bottom cars, could be handled entirely mechanically. At certain points the loading was done directly from the elevating conveyor, while at several other points, large capacity elevated storage bins were provided, with chutes discharging directly into the bin cars. The latter arrangement proved by far the most satisfactory, loading of the three bin cars of a train being possible with this arrangement in from 15 to 20 minutes, whereas, where no storage bins were provided, loading of the same cars required from 3 to 4 hours.

Various Sizes of Footing and Anchors

Various sizes of pole footings and guy anchors were used in the bridge construction, but generally they are each of one specific type. The pole footings consist of a slab mat with a center pedestal, the mats of the different footings ranging in size from 7 ft. by 7 ft. by 2½ ft. thick, to as large as 12 ft. by 12 ft. by 3 ft. thick. The pedestals were increased in size only slightly with increased size of the mat, ranging from about 3 ft. 8 in. square to 4 ft. square. The height of the pedestals was made 5 ft. or more, depending largely upon ground conditions.

To permit ready erection of the poles subsequent to the construction of the footings, each of the footings was poured with a vertical center well, extending through the pedestal and into the base mat. The forms used for these wells were suitable lengths of corrugated iron pipe.

The guy anchors practically throughout the bridge work were of the slab type, poured in place, although,



Setting the Top Section of One of the Highest Poles Used in the Electrification

precast conical-shaped anchors were used to some extent in the main line territory between New Brunswick, N. J., and Trenton. The slab anchors were of two general sizes, 2 ft. by 6½ ft by 1½ ft., with a 1½- or 1¾-in. anchor rod, and 4 ft. by 6½ ft. by 1½ ft., with a 2-in. anchor rod. These slabs, which encased two steel channels, back to back, to form anchorage for the anchor rod, were placed horizontal and usually about 10 ft. below the surface of the ground. The guy rod, to a point above the ground line, was housed in a steel tube filled with cement grout to prevent its becoming corroded through contact with the ground.

The precast conical-shaped anchors used in a part of the work were 30 in. in diameter, and were buried in holes dug by a tractor-mounted auger. About 20 per cent of the anchors installed between Trenton and New Brunswick were of this type, they being used only where the contour and consistency of the ground were particularly suited for the operation of the auger equipment.

Special Cranes Set Poles

Erection of the poles was done as effectively and expeditiously as the pouring of the pole footings, by specially designed steam cranes, with extension booms, which were moved over the road in work trains.

The outstanding feature of the cranes used was the fact that the revolving platform, containing the hoisting drums and control cab, was free of the boiler, which was located in a stationary position behind it. This feature of design made it possible to decrease the length of the revolving platform to the point where under no circumstances did its rear end extend outside the normal side clearances of the crane car mounting. Thus, the cranes presented no hazard to trains on the adjacent track, and were, therefore, operated continuously without regard to train movements on that track.

The cranes had 50-ft. booms and 30-ft. boom extensions. Without out-riggers, the 50-ft. boom had a safe lifting capacity of 12 tons at 15-ft. radius, while the extended boom had a safe lifting capacity of 8 tons at 20-ft. radius. Twenty feet was the minimum radius at which the extended booms could be used.

In setting up the poles, which had been distributed along the right-of-way prior to the arrival of the erecting crew, the crane picked up a pole and, while holding it in a nearly vertical position, set its lower end into the well in the footing, where it was made to rest on a steel base plate. While held practically true, stone spacer blocks were dropped to the bottom of the footing well, alongside the pole, to center the base accurately; then oak wedges were driven around the top of the opening to support the pole temporarily in an approximately vertical position.

In a second stage of erection, the poles were plumbed by means of transits and were then made secure with the wedges. In a third stage, which followed the earlier stages closely, the bases of the poles were concreted in solidly by a crew which hand-mixed the concrete at each pole site. First the concrete was brought up only to the bottom of the wedges, which were allowed to remain in place until this concrete had become set. Later, the wedges were knocked out and the remainder of the concrete was poured. In subsequent operations, the transmission line crossarms were bolted in place and the poles were given their two field coats of paint.

Roadway Changes Required by Electrification

ONE of the difficult roadway problems of the Pennsylvania electrification was that of obtaining adequate overhead clearance for pantograph operation and for the movement of high freight loads. In the Philadelphia to New York section of the electrification alone it was necessary to raise 11 overhead bridges, including one carrying a canal, and to lower approximately six miles of tracks in the six, single-track tunnels under the North and East rivers at New York. In the open on main line tracks, a clearance generally of 22 ft. 0 in. was maintained between the top of the rail and the contact wire, but under most bridges and in the tunnels this was impossible. At each of these points the situation presented was studied jointly by the operating, motive power, transportation, electrification and maintenance of way departments, and the clearance finally agreed upon was determined as the result of balancing carefully the clearance requirements for electrical and transportation purposes against the cost of obtaining them.

In addition to the problem of securing adequate operating clearances, it was necessary to provide suitable physical and electrical clearances for the new catenary and high tension line supporting structures. This involved primarily the removal of existing pole lines carrying communication, signal control and secondary power lines, and the placing of these circuits either in underground duct systems or in aerial cables carried on a separate line of poles.

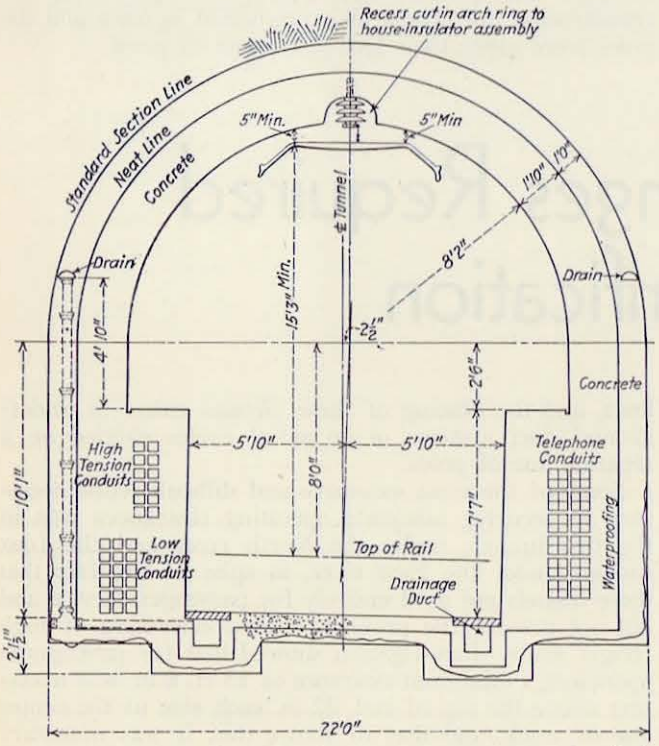
Some of the most extensive and difficult work necessary in securing adequate operating clearances was in the two tunnels under the North river and the four tunnels under the East river, in spite of the fact that these tunnels are used entirely for passenger service and did not present the problem offered elsewhere of high freight loads. Investigation showed that for pantograph operation, a minimum clearance of 15 ft. 8 in. was necessary above the top of rail, 32 in. each side of the center line of track, and that to secure this, it was necessary to lower the tracks from 2 to 8 in. in all 6 tunnels, in addition to recessing the contact wire insulator assemblies in the tunnel roof from 5 to 10 in.

In the design of the river tunnels, consideration had been given to the possibility of overhead electrification, and clearance was provided for catenary construction and pantograph operation. Routine track maintenance and surfacing work gradually caused the tracks to be raised to an elevation which, combined with irregularities in the roofs of the tunnels and an increased height of rail section, would not permit pantograph operation at the time the overhead contact system was installed.

Track lowering operations were therefore required and were undertaken in one tunnel at a time, progressing from one end to the other, with complete resurfacing of the track as the work progressed. Because of the density of train movement, all of the actual lowering operations were carried out between 2 a.m. and 5 a.m., the period of lightest traffic, when the track was given over to the track forces. Altogether, about 20,000 cu. yd. of ballast were removed from the six tunnel tracks. A detailed story of the work of lowering the tracks under the North and East rivers appeared in the issue of Railway Engineering and Maintenance for September, 1931.

The additional clearance required in each tunnel over that possible through lowering of the track was obtained by cutting recesses in the crown of the tunnel arch to house the trolley insulator assemblies. The arch ring was also grooved longitudinally, directly above the trolley wire and each way from the insulator recesses for a distance of 15 ft. This was done largely by air drills, operated from cars of a work train, which also carried the air compressor equipment.

Another rather unusual and extensive piece of tunnel revision made necessary by electrification was carried out in what is known as the Thirty-Second Street tunnel, in West Philadelphia, a structure 754 ft. long, extending longitudinally directly beneath Thirty-Second street. This tunnel carries two tracks, and, prior to its reconstruction, had ashlar masonry bench walls and a six-ring brick arch. As its width of 24 ft. and height of 16 ft. would not provide sufficient clearance for the electrified equipment,



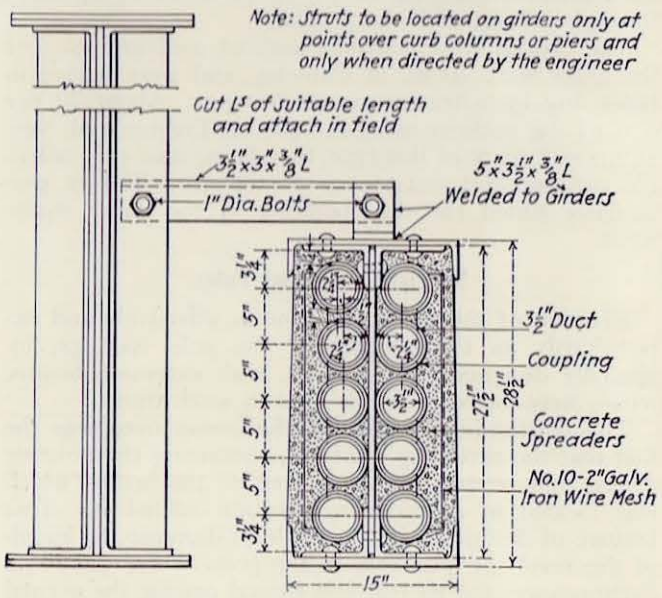
Typical Section in One of the Hudson River Tunnels at New York, Showing Clearances Provided for Overhead Contact System

the reconstructed tunnel was made of the rectangular type, 31 ft. wide and 18 ft. 6 in. high.

The work of enlarging the tunnel involved intricate detailed planning and a number of unusual structural problems. While single-track operation—involving the movement of about 325 trains daily through the tunnel, and heavy street traffic over an important street crossing at each end of the tunnel—was maintained, the old arch ring and bench walls were completely removed and were replaced by the larger rectangular steel and concrete lining in a total of 144 days. A detailed account of the work of enlarging this tunnel appeared in the *Railway Age* for March 5, 1927.

Many Bridges Had to Be Raised

In addition to the tunnel work, a large number of bridges had to be raised in the electrified territory and, either in conjunction therewith, or by itself, a considerable amount of track lowering was done. As already



Typical Method of Carrying Multiple Ducts Over Street and Stream Crossings

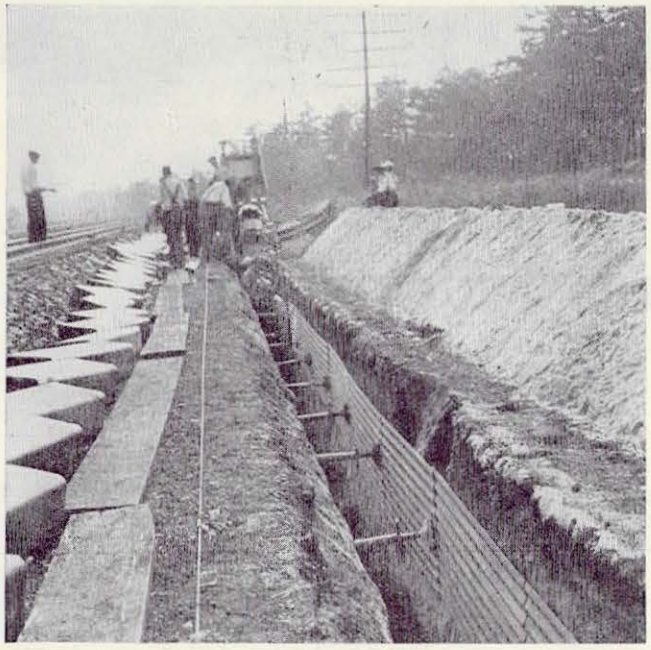
stated, 11 bridges of various types were raised between North Philadelphia and New York, the amount of raise varying from about 6 in. to 35 in.

Some of the most extensive and interesting work of raising bridges took place within Trenton, N. J., where it was found desirable to increase the vertical clearance under six street bridges, a single-track railroad bridge and a canal aqueduct. The street bridges raised were all of the girder type, encased in concrete, and carried important street traffic. Raising of the bridges was effected in a more or less similar manner, by jacking from beneath, but in certain cases where there was insufficient lateral clearance between operating tracks and the abutments it was necessary to do the jacking from above.

All of the work was done without interfering with rail traffic, using an adequate number of high-capacity hydraulic jacks to effect the lifts uniformly and without introducing destructive strains in the structures. Because of the width of the bridges and the necessity for a minimum of interference with street traffic, a couple of the structures were raised one half at a time, although, in one case, two of the bridges, which intersected and were joined structurally at one end, had to be raised in their entirety at the same time. In all instances the bridges were blocked as raised, and, ultimately, were made to rest on heightened bridge shoes or heightened masonary bridge seats and piers. That a large degree of success was attained in raising these bridges, without damaging them, is evident from the fact that in no case was the concrete encasement of the steel cracked or broken away, not even that in the thin sections encasing the facia girders.

The raising of the single-track railroad bridge at

Trenton, a girder structure, was not unusually difficult, as may also be said of raising the canal aqueduct, but the latter work was the more interesting and required extensive alteration of the canal itself to afford the same depth of water in the aqueduct after the raise as before. The aqueduct over the tracks, which is 90 ft. long between abutment supports, is of steel girder and plate construction. This was raised 30 in. during the winter months when the water was out of the canal, hydraulic jacks being used as in the case of the street bridges.



Laying a Section of the Underground Multiple Duct System Between New York and Philadelphia

Raising of the aqueduct crossing of the railroad required that a new lock be provided immediately south of the crossing to restore the depth of water in the raised aqueduct, and this, in turn, required that the stone masonry side banks of the canal itself be built up three to four feet for a distance of approximately 2,200 ft., back to the first existing lock north of the aqueduct.

Another item of bridge work brought about by electrification was that of screening all street bridge railings or ballustrades to a height of 6½ ft. above the sidewalk level. This was done primarily to minimize the temptation to throw things over onto the railroad, especially any electrical conductor which might cause damage or injury if it should come in contact with the trolley wire.

In the case of unencased girder bridges, or those with metal railings, this screening was effected by the installation of steel ornamented plates of the desired height, completely obscuring the railroad from view. Where concrete encased through girders were involved, the concrete encasement was extended to the desired height above the original top of the girders in the form of a curtain wall.

Communication Lines Put Underground

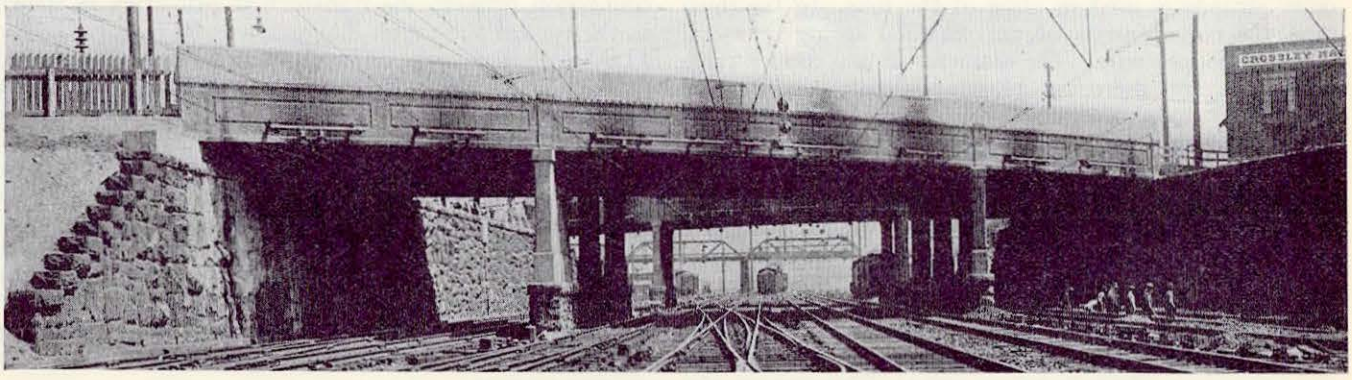
Another of the important field items which it was necessary to carry out prior to the actual field work of the electrification proper was the disposition of communication, signal control and secondary power lines, either suitably overhead or underground, to provide adequate structural and electrical clearance for the new power lines to be erected. In the branch-line territory electrified, these lines were placed in aerial armored cable, suspended on separate line of poles, but in all of the main line work they were placed underground in multiple-section ducts.

In this latter work, the ducts were laid generally along the shoulder of the roadway, and were switched from one side to the other, where necessary, to take advantage of the most favorable trenching conditions and to provide proper routing of the cables. Most of the trenching was done by hand either because of the character of the ground or limited clearances along the outside shoulder, but for considerable distances trenching machines were employed to good advantage. All of the ducts were laid below the frost line and were pitched for drainage between concrete catch basins or manholes spaced from 500 to 600 ft. apart.

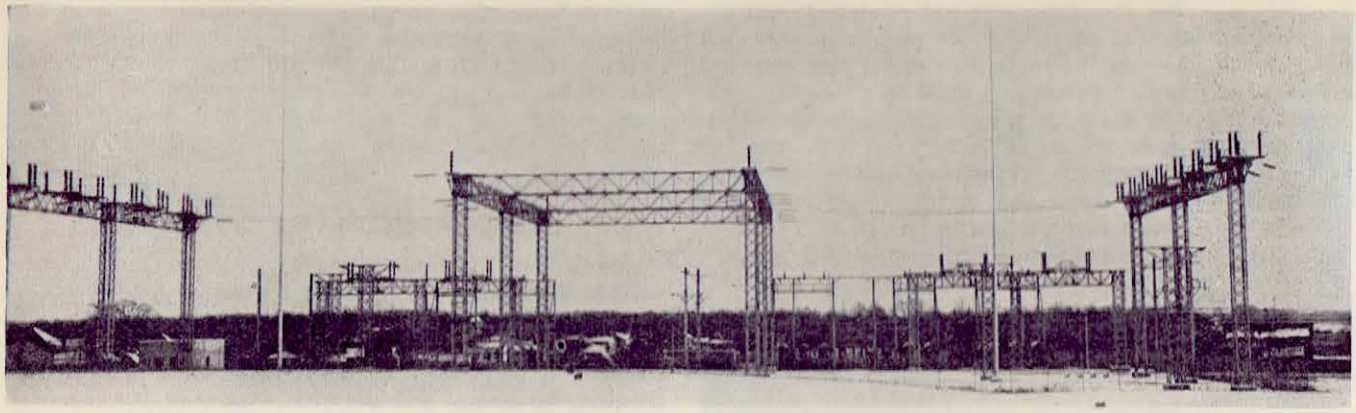
The installation of the ducts required considerable shoring of the trench especially when close to the tracks or when crossing under the tracks. The trench under the tracks was timbered up to carry traffic while the installation of cross ducts was being made. The duct sections under tracks were encased in six inches of concrete, with reinforcing rods longitudinally.

One of the most interesting expedients employed in the duct work was that used to carry the wires across existing street and waterway bridges. Here, instead of suspending the wires in the open or in cables beneath the superstructure, they were enclosed in specially designed composite steel and concrete duct boxes, which were made to span the bridge openings and to rest on the bridge abutments or piers, altered where necessary.

Essentially, the duct boxes consist of two steel channels, one above the other, separated by, yet held together by a web plate joining their longitudinal center lines. On both sides of the web plate are five lines of fibre duct, one above the other, which are encased in concrete, the outside face of which is flush with the outside flanges of the channel top and bottom pieces.



These Two Bridges at Trenton, N. J., Were Raised About Two Feet on Steel Plates, Afterward Encased



Type of Step-Down Substation Used Where Space Available Permits

Transmission, Substations and Catenary System

FROM the step-up substations the 132,000 volt, 25 cycle, single-phase power is distributed to outdoor type substations located along the right-of-way where the voltage is stepped down to 11,000 for the distribution or catenary system. Over the greater part of the electrified section there are four such single-phase or two-wire transmission lines feeding substations which are from 7 to 10 miles apart. The same H-column section poles which support the catenary system also support the transmission lines as shown in several of the illustrations. The transmission line wires are supported on suspension insulators made up of 11 units, each unit having a dry flash-over voltage of 75,000.

Both hollow-core copper stranded and steel aluminum stranded cable are used for the transmission line. The steel core of the aluminum cable serves to give increased tensile strength and the hollow core of the copper stranded serves to increase the outside diameter of the cable, thereby reducing the possibility of radio interference. As an added precaution against radio interference, the clamps which attach the cables to the insulator strings are streamlined or smoothed to eliminate all sharp edges. Three types of hollow-core copper strand cable are used. In one of these the outer strands are twisted around a copper tube. In another, a small I-beam section twisted in the opposite direction to the outer strands is used in place of the tube. In the third type, the core consists of an extended spring or spiral made of copper wire. The diameter of the copper cable is .731 in. and there are 14 strands making a total of 250,000 cir. mils. The steel core aluminum strand is .86 in. in diameter and is equivalent of 300,000 cir. mils. copper.

A 4/0-7-strand-copper ground wire is run above the transmission line wires along the tops of the H-column section poles. The ground wire support on each pole cap constitutes an electrical connection and the poles are grounded at certain points (usually at every other signal bridge location) by connecting them to the mid-point of impedance bonds. This connects the overhead ground or static wire to the rail at these points. This ground wire is in parallel with an inductive neutralizing and lightning protective underground wire; the latter being connected to the center of impedance bonds at approximately four signal intervals.

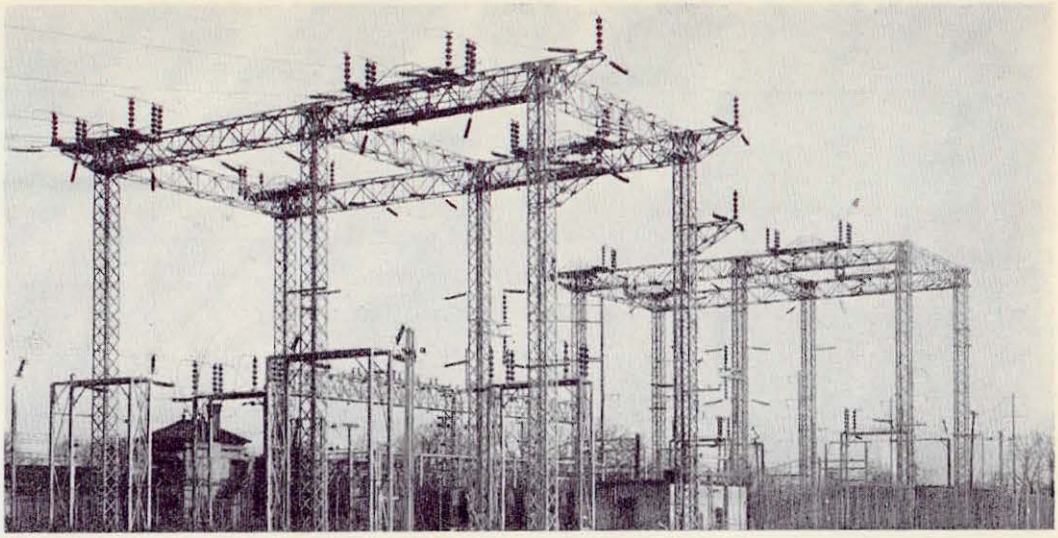
A 6,600-volt signal power line is also carried on a small crossarm mounted on the H-section poles on one side of the railroad below the transmission wire and above catenary supports. For this purpose, 1/0, 7-strand copper wire is used mounted on pin type insulators.

Substations

All of the four transmission lines are fed into the primaries of the step-down transformers at all substations through motor-operated remotely controlled air-break disconnecting switches. These switches are so arranged that either one of two of the 132,000-volt circuits may be connected to one 4,500 kva. step-down transformer; either one of the other two 132,000-volt circuits may be connected to the second 4,500 kva. step-down transformer. The substations are so designed that two additional 4,500 kva. step-down transformers may be added, thus providing one transformer per transmission circuit at each substation.

A simplified diagram of the principal power circuits in a typical substation is shown in the section entitled "Power Supervision, Switching and Sectionalizing". When the four transformers are installed, the present connection between the transformer primaries as shown in the typical substation diagram will be removed. The 11,000-volt secondary of each transformer is connected through an oil circuit breaker and a disconnecting switch to an 11,000-volt bus. The parts of the bus fed by the two transformers may be separated by a bus-tie oil circuit breaker. Power from the bus is fed through the requisite number of high-speed trolley breakers to the catenary or contact system. At a standard 4-track interlocking 10 trolley breakers are required. An 11,000-volt lightning arrester is connected to each trolley circuit between the high-speed trolley breaker and the catenary. Disconnecting switches allow the isolation of lightning arresters and high-speed trolley breakers for inspection or maintenance.

Substations of two general designs are used. Where



Type of Step-Down Substation Designed for Restricted Sites

space permits, the steel work which supports the buses, the 132,000-volt transmission lines and the air-brake disconnecting switches are at one side and not directly over any of the 11,000-volt circuits or apparatus in the substation. Where space is at a premium, a more compact type of substation is used, in which the transmission lines are above other substation equipment.

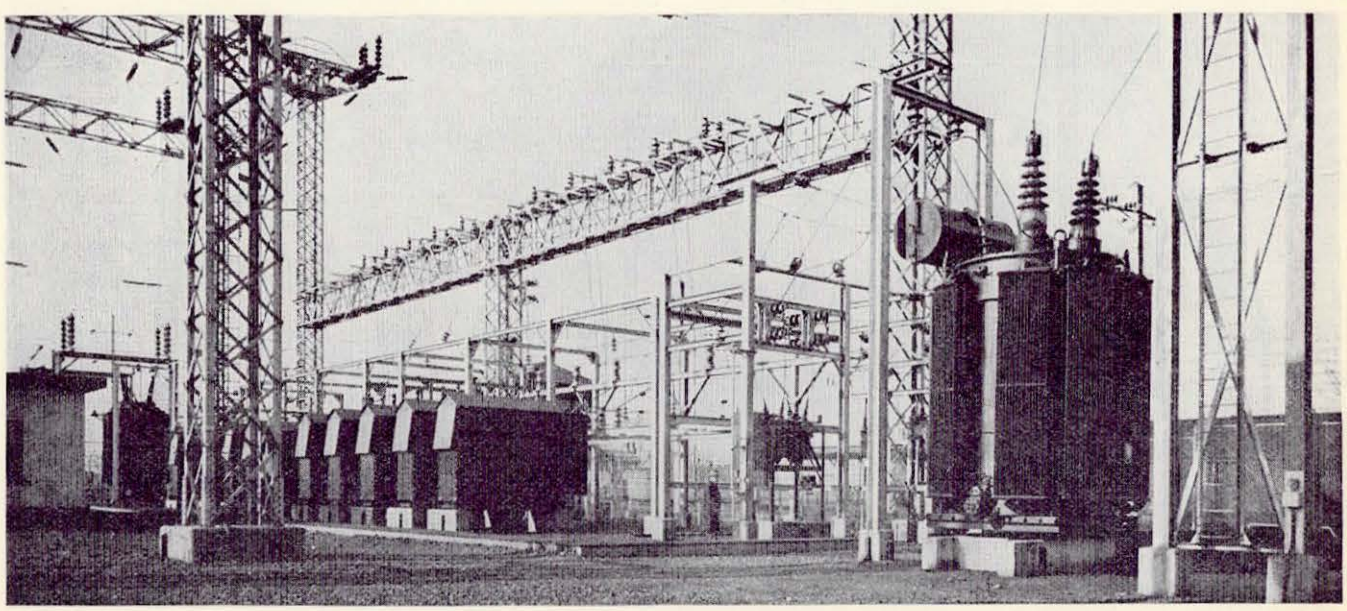
In locating the substations, some of the more important considerations include the voltage regulation desired, the distribution of loading, possible inductive effects, the proximity to natural sectionalizing points such as interlockings, convenient points for the installation of suitable control, and the availability of real estate.

In general, all of the substation sites were provided with adequate sub-drainage, were leveled off and then paved with cinders. All structural footings and electrical equipment foundations were made of concrete, which was prepared by portable mixers on the ground, or by the concrete trains, described elsewhere in connection with the right-of-way pole line construction.

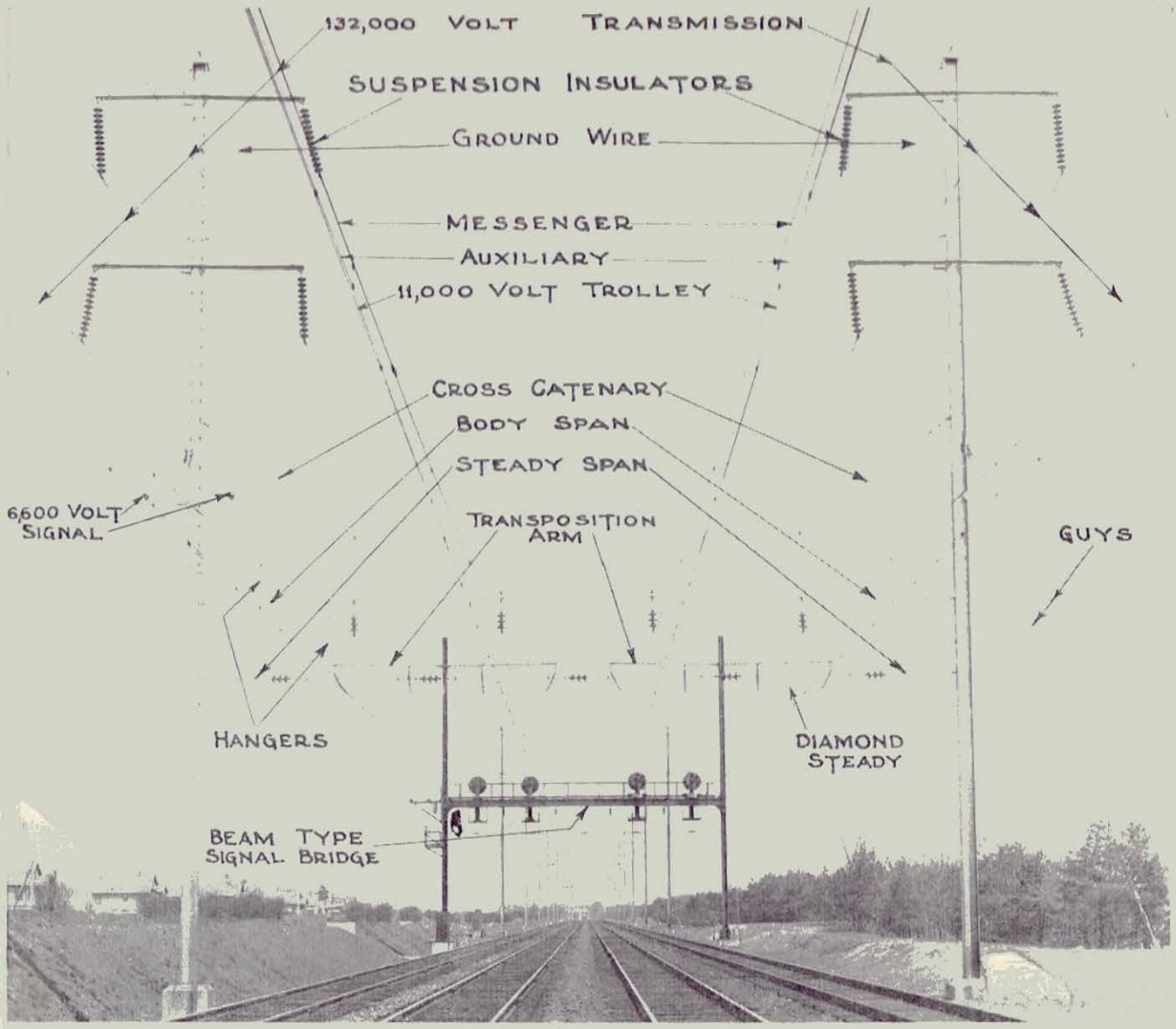
The wire and electrical equipment supporting steelwork at the stations is generally of the lattice truss type, both as regards columns and span members, this type of construction being particularly adapted for such use because of the high towers and long spans required, which are called upon to carry only relatively light loads. Furthermore, by this type of construction, the weight of the steelwork is reduced materially, wind resistance is cut down, and visibility in following circuits or observing operations is materially improved. All of the steelwork at the stations, which is galvanized as a protection against corrosion, was erected by the contractors, using two specially adapted tractor-mounted cranes, each fitted with a 100-ft. boom.

Each substation has a service track, which was used both in delivering materials for construction, and for the transformers and other heavy units of electrical equipment. Wherever possible, this service track was extended through the center of the substation area and was given a trailing point switch connection with the adjacent main line track. At one station site considerable difference in elevation between the level of the site and that of the main tracks made it impossible to establish a direct service track through the station area. Here, a service track was established between the main tracks and the station site, and the transformer tracks of the station layout were extended so that equipment could be lowered by a derrick directly from the service track to the transformer tracks.

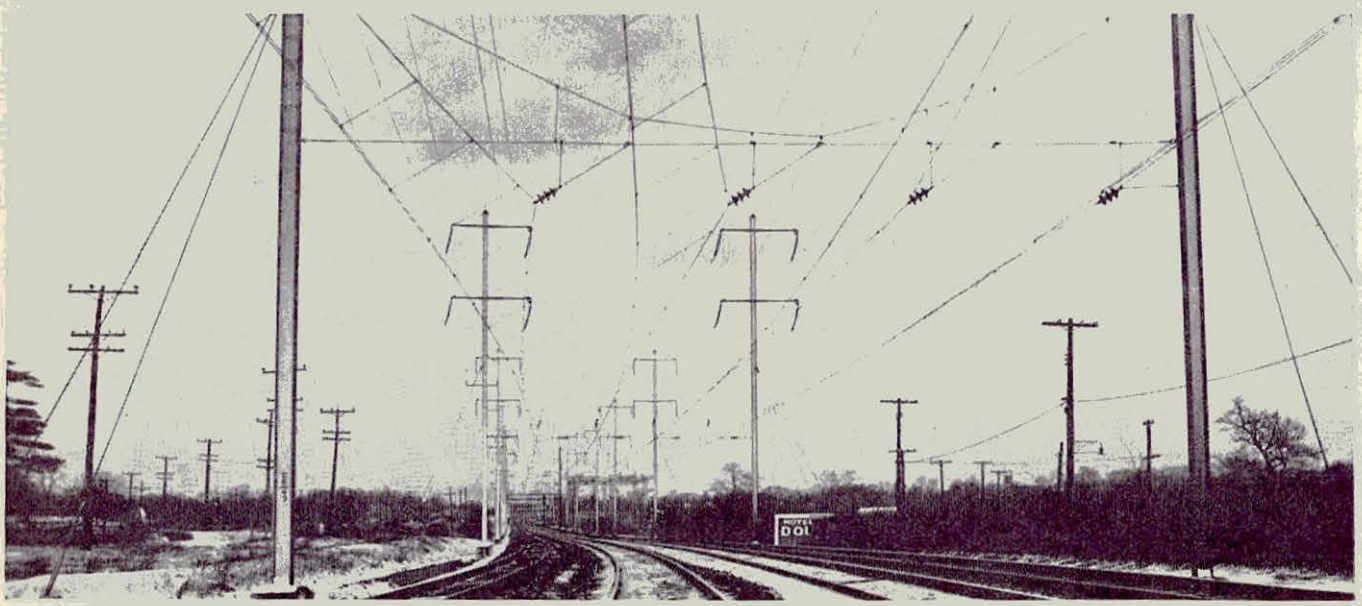
The control building at each of the substation sites is a one-story structure, 40 ft. by 25 ft., or smaller, in size. All of the buildings are of cement block construction,



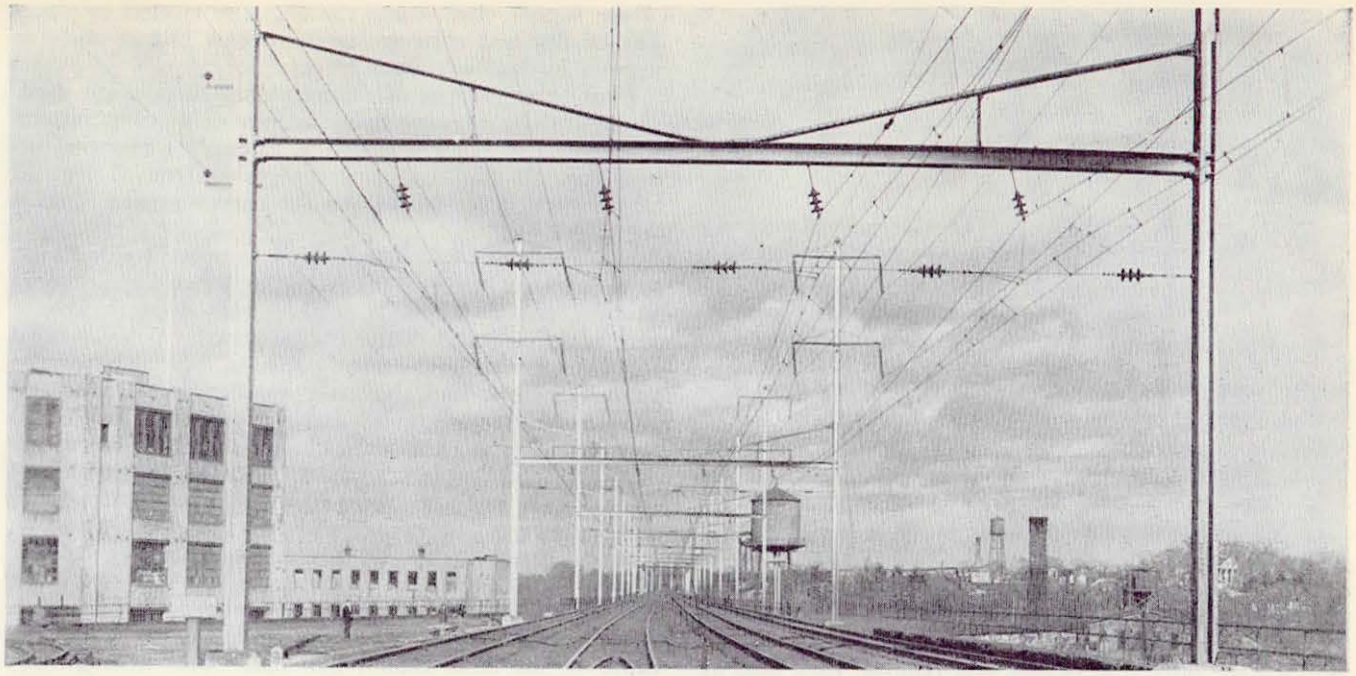
View Inside of Step-Down Substation Showing Arrangement of Transformers, High-Speed Trolley Breakers, Air Switches and Control Building



Tangent Catenary with Cross Catenary Support



Inclined Catenary for Curves from 2 Deg. 30 Min., to 4 Deg.



Cross-Beam Bridge Supporting Type of Catenary Used on Curves up to 2 Deg. 30 Min.

with concrete roofs and floors, and with stucco faces to improve their appearance.

In most instances, substations are located near track interlocking plants where cross-overs are provided, which permit trains to cross from one track to any other. Ten circuits through the ten high-speed trolley breakers feed the contact wires respectively over the four tracks in either direction and two island sections of trolley which permit cross-over operations. The ten sections of contact wire fed by the trolley breakers are separated from each other by section breaks and are connected only through the breakers and substation bus.

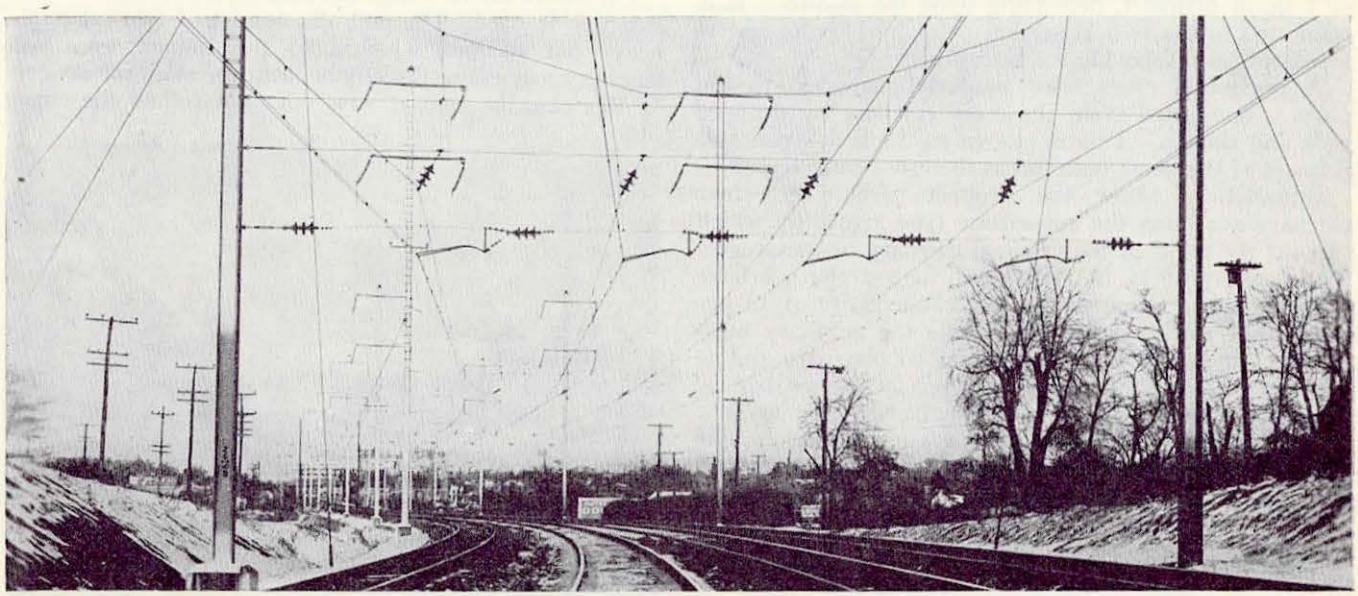
A section break is an opening in the contact wire. The wires from opposite directions are carried past each other but do not touch. Each wire is lifted up to a strain insulator so that a passing pantograph slides off of one wire and onto the other, electrically connecting the two wires for a short distance as it passes.

The control building within the fenced enclosure of each substation houses the switch control equipment; most of these buildings also include signal control and the motor generator set for supplying signal power. Power switches may be controlled from this building as well as from the nearby interlocking tower. Power for the operation of switches is obtained from a small motor-generator charging set operating in conjunction with a suitable storage battery. All control circuits are carried underground in parkway cable.

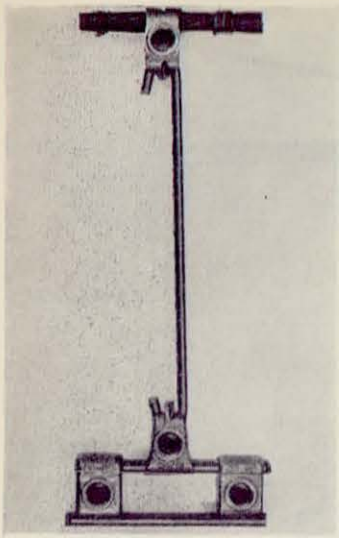
Oil of transformers and oil switches is filtered or cleaned only when a voltage break-down test of a sample indicates the desirability of so doing. Centrifuge cleaners are used for removing sludge and water after which paper filter presses remove the last traces of moisture and suspended carbon.

Most of the substations have tanks and piping for containing and handling the oil while it is being cleaned or filtered. In most cases this equipment is placed underground; in several substations it is above ground and two stations are built without such tanks or piping.

When the cleaning of transformer oil is necessary, the



Chord Construction for Curves Greater than 4 Deg.



Riveted Hanger and Clips Used for Main Catenary —The Clips are Spaced 7½ ft. on Either Side of the Hanger on Tangent Catenary

tank for receiving the oil from the transformer is first cleaned inside and washed down with oil; then all the oil is run into the tank. It is taken from the tank through the purifying system and pumped back into the transformer. Separate tanks are used for oil switch oil, and transformers and oil switches are connected by pipes to a manifold in the control building. The manifold permits the connecting of the purifying apparatus to any desired piece of apparatus. In addition to providing space for oil storage during cleaning, in emergencies the oil may be drained quickly into the tanks.

In the two substations not equipped with tanks and piping, oil is conditioned with the aid of a tank car and portable filter and centrifuge.

Catenary System

Two general types of supporting structures for the catenary system are used. Where side guys and anchors can be placed, a cross catenary support is used. On restricted right-of-way, or where there is no place for guys and anchors, a braced cross beam is used in place of the cross catenary and guys. The primary reasons for the selection of the cross catenary as compared with the cross beam are better visibility and lower cost.

The cross catenary proper or supporting cable consists of a 19-strand, high-strength bronze cable, ⅝ in., ¾ in. or 1 in. in diameter, depending upon the loading. It is connected to the two H-section poles by U-bolts and is fitted with a turnbuckle for adjustment.

A horizontal cross wire similarly connected to the poles is supported from the cross catenary by dropper rods and clamps. This is known as the body span and is made of the same material as the cross catenary.

Immediately below the droppers from the cross catenary are hung the suspension type insulators which support the main or longitudinal catenary or messenger. This consists of ⅝ in., 19-strand, high-strength bronze cable, having a copper equivalent conductivity of 13 per cent. The next wire below that is the auxiliary messenger. It is a 4/0 grooved solid copper wire and is supported from the main messenger by bronze hanger rods. These rods are .34 in. in diameter on tangent track and .42 in. in diameter on curved track. The hangers are spaced 30 ft. apart on tangent track and 15 ft. apart on curved track.

The contact wire is a 4/0 grooved solid bronze wire with approximately 40 per cent copper equivalent conductivity. It is supported from the auxiliary messenger by clips spaced 15 ft. from each other, the clips adjacent to the hangers being 7½ ft. from the hangers; there are two clips between each hanger on tangent track. Both of the hanger clamps and the clips are riveted in place. The clamps and clips are made of cast bronze and are secured by hollow copper rivets.

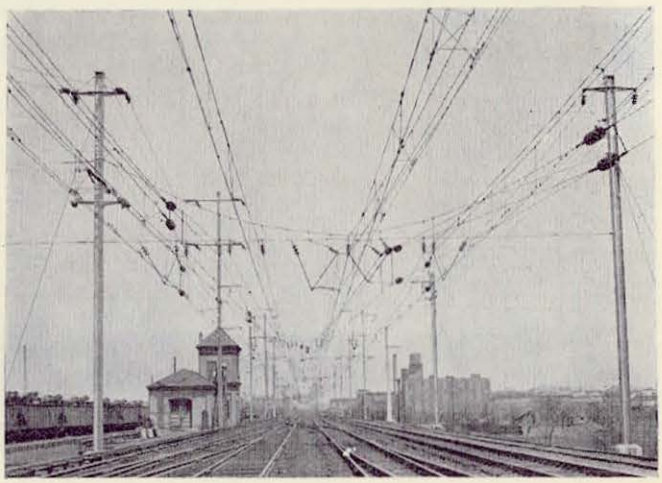
Four general types of catenary construction are used. These are shown respectively in four of the illustrations and consist of tangent catenary, catenary for curves up to 2 deg. 30 min., catenary for curves from 2 deg. 30 min. to 4 deg., and catenary for curves greater than 4 deg.

It is necessary on tangent track to prevent side swing of the contact wire. This is accomplished by means of steadies. A 7/16 in., 7-strand, high-strength bronze wire connected across the tracks between poles is used for this purpose. The steady span is located below the main messenger and above the auxiliary messenger and is insulated from ground and divided electrically into four parts (one part for each horizontal catenary) by five three-unit insulators. Two .48-in. diameter bronze steady rods are attached to each auxiliary messenger with a clamp. The other ends of the rods extend in opposite directions to bronze castings attached to the steady span, the upper or outer end of the rod being hooked through an eye in the casting. The rod may slide through the eye when the trolley is raised but because of the hook cannot pull out. This arrangement permits the rise of the contact wire, due to temperature change or the action of a passing pantograph, without causing a hard spot.

On curves up to 2 degrees and 30 minutes, the same type of construction is used, except that the two steady rods which hold the auxiliary messenger both pull in one direction against the curve of the wire. In this type of construction, short hangers between the auxiliary messenger and the contact wire are used in the place of clips over a short section near each bridge or cross catenary.

On curves from 2 deg. 30 min. to 4 deg., the unsteadied inclined type of catenary is used. Hangers are spaced 15 ft. apart instead of 30 and the lower part of the hanger terminates in a clip which grips both the auxiliary messenger and the contact wire and is set at an angle to the hanger so that the contact wire is held directly beneath the auxiliary messenger. The weights of wires are balanced against the curve pull so as to cause the contact wire to follow closely the curve of the track. A passing pantograph lifts the contact wire and auxiliary messenger and swings them on the end of the hanger about the main messenger as a center.

On curves above 4 deg. the tangent chord type of construction is used. The pull-offs consist of two relatively heavy flat sections which hold the contact wire and auxiliary messenger directly beneath the main messenger. In this case the contact wire does not follow the curve



An Interlocking Showing Section Breaks and Island Trolley Sections

of the track but extends in chords from one point of support to the next.

For yards, terminals and sidings where it is not necessary to provide for high-speed operation, a simple catenary is used; the auxiliary messenger is eliminated and the contact wire is supported directly from the main messenger.

Insulators

Five types of insulators meet practically all of the requirements of high-voltage power line, signal power line and catenary.

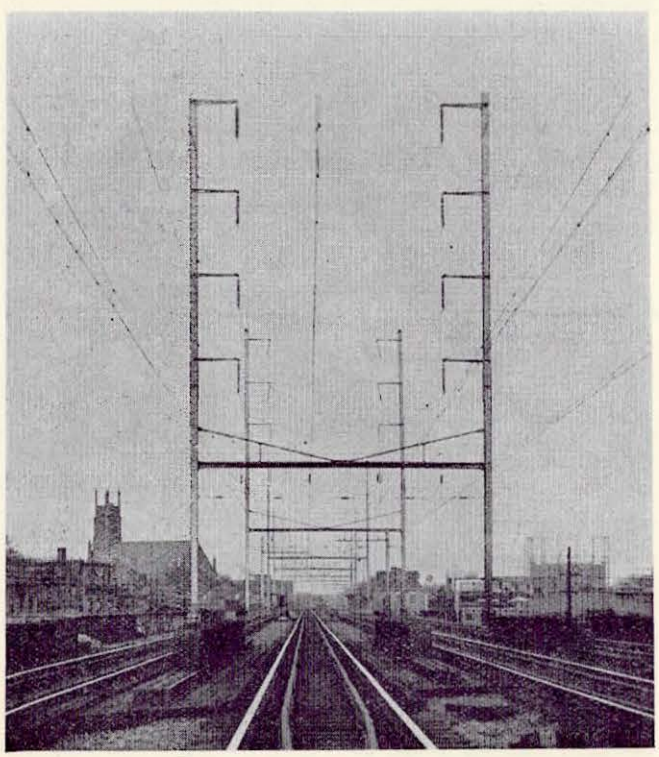
The B1 insulator has a diameter of 10 inches and a spacing between units of 5¾ in. It is a clevise type suspension insulator and is used both for catenary and transmission line. It has an ultimate mechanical strength of 12,000 lb. and is used with a maximum working load of 4,000 lb. Three units in a string are used in the 11,000-volt catenary and 11 units for suspension insulators in the transmission line. In power-line strain insulators the number of units is increased to 13.

The A1 insulator has the same dimensions as the B1 but has an ultimate tensile strength of 20,000 lb. and is applied for loads up to 6,500 lb. It is used only for the catenary.

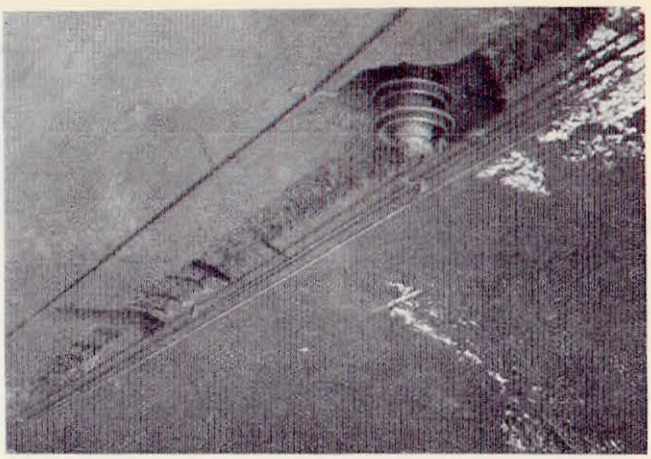
The A2 insulator was designed for catenary dead-end; it is 12 in. in diameter and the spacing between units is 6½ in. It is of the suspension clevise type and has an ultimate mechanical strength of 30,000 lb. It is used in service for dead-ending and for sectionalizing and is applied for loads up to 10,000 lb.

The type S insulator is a two-part, pin-type unit having a 7½-in. minimum overall dimension and a 95,000-volt dry flashover and serves to carry the signal 6,600-volt power supply lines.

The type L insulator was designed especially for tunnel and under bridge catenary support. Because of limited clearances, it was necessary to have an insulator with very small vertical dimensions. It also had to resist corrosion and have high lateral strength; and be supported at the top and resist side pull or cantilever strain

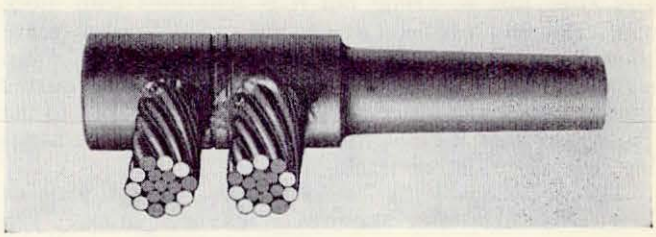


Type of Structure Used on Restricted Right-of-Way



Tunnel Insulator in One of the Hudson River Tunnels

from the catenary at the bottom. The insulator is an entirely new form which has a height of four inches per unit. Each insulator assembly is made up of three units screwed together. Screws and fittings are bronze. Each unit has a dry flashover voltage of 70,000 and a tensile strength of 15,000 lb. ultimate. The critical stress is



Power Bond Terminal Showing Cross Section of the Two Composite Strands

caused by cantilever action of the catenary and the insulator assembly of three units will stand an ultimate load of 2100 lb. applied horizontally at the catenary support. In the tunnel sections the top of each insulator is recessed into the roof from 5 to 10 in., this recessing being extended for about 15 ft. either side of the insulator to furnish clearance for the main messenger.

Bonding

The rail bonds are modified signal type pin bonds. They consist of tapered pins connected by two conductors. Each conductor is made up of a stranded copper center consisting of seven .064-in. diameter strands surrounded by an outer layer consisting of three .077-in. tinned copper, and seven .077-in. galvanized steel strands. The rails are drilled with a ⅜-in. drill and the tapered bond pins are driven in with a hammer. The bonds have a safe carrying capacity of 400 amperes at 25 cycles without undue heating.

This simple form of bonding has been found satisfactory and the first cost and installation cost are much less than those of the expanded terminal type and gas-weld type previously used. The steel strands prevent mechanical failure and the composite structure also reduces the possibility of theft, since the salvage of the copper is impracticable. The bonds are maintained by the signal maintainers and eliminate the need of any special maintenance facilities. It has been determined by experience and calculations that the somewhat increased resistance losses incurred by this type of bond are of little consequence as compared with the savings effected by low first cost and reduced maintenance.

Erection of Catenary

AFTER the erection of the poles the next operation was the attachment of the side guys and the straight wire between the poles known as the body span. Both guys and body span are fitted with turnbuckles and these are used to take out the slack so that when they are properly tensioned the poles will be vertical. A transit is used to plumb the poles during this operation. Following this, the rest of the cross catenary and fittings, except those of the steady span, are placed.

While the cross catenary is being erected, a separate crew applies cross arms and insulators preparatory to the stringing of the transmission line wires. The structures are then "ready to take wire."

The transmission line wires and longitudinal catenary are strung simultaneously by separate crews. The first wire of the transmission assembly is the ground wire, following which the four transmission line wires are strung in sequence. The wires are pulled from a stationary reel on the ground over sheaves hung on the poles. Either horses or a winch on a truck are used to do the pulling. Each reel contains about a mile of wire and after this is strung out it is tensioned with block and tackle and a tension dynamometer. The sheaves are then removed and the insulator clamps applied. In stringing the wire, the outside sheaves are hung on the insulators and the inside wire sheaves are attached to the cross arm near the pole to avoid having the wire hanging over the adjacent track.

The stringing of the messenger wire for the main or longitudinal catenary requires track occupation. The work is done with a wire train consisting of a tool and material car, a reel car, tower car or cars, locomotive and caboose. The tower cars have platforms of adjustable height.

One end of the messenger cable is taken from the reel, connected to a permanent attachment, usually a signal anchor bridge, and strung loosely over sheaves, which are hung from the insulators on the cross catenary. When the end of the wire is reached, the slack is pulled, the wire given preliminary tension and snubbed to the nearest available structure. The wire on another reel is then spliced to the first and the process continued for three or four reels, depending upon the length of track available. The type of joint used consists of two parts, one swedged to each wire end. These parts are fitted with a male thread and the two are held together by a sleeve screwed over the outside, the sleeve being secured by a lock nut.

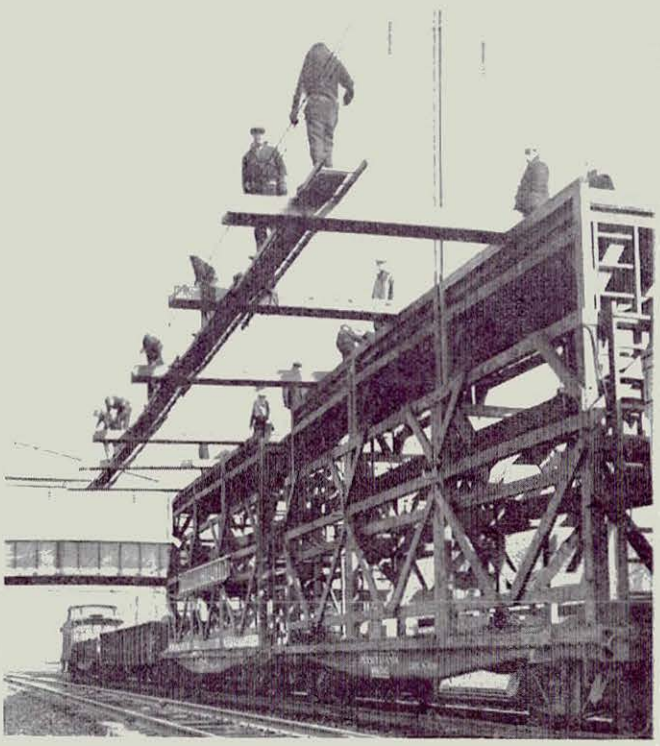
When several reels have been run out, all the wire that is up is pulled to a greater tension and intermediate snubs at the wire joints are removed. The tension is then increased to something greater than the specified unloaded tension and the cable is left under this tension for two or three days to allow for equalization of tension in spans. The tension is then tested at intervals along the wire by a shunt dynamometer. This is a device which holds the wire at two points and applies pressure at an intermediate point. The amount of deflection at the mid point provides a measure of the tension of the wire. This measurement serves to determine whether or not the tension is correct and usually discloses inequalities of tension in spans. To equalize the tension, the wire is pulled at several points, sometimes back and forth, and every effort is made to see that slack is carried through each support; this is facilitated by hauling laterally on the wire with a hand line. The adjustment of tension is given much attention, as uniform tension of the main messenger is pre-requisite to a satisfactory catenary system.

The next operation is the application of hangers to the main messenger. These are made up in the shop to different lengths from computed tabulations and are applied by wiremen riding the messenger in boatswain's chairs. Position of the hangers is determined by measurements made along the rail. The measurements are given to the messenger riders by a man on the ground, using a special square resting on the rail. The vertical member of the square is equipped with two sights and a mirror, and is hinged near the rail so that one rail measurement can be used for sighting-in the hanger position on all messengers.

The auxiliary messenger and the contact wire are strung out simultaneously and supported temporarily by wire hangers while they are pulled to approximate tension. Temporary splices are made between the wire ends and as much wire as possible is snubbed to a preliminary tension. Then the tension is pulled at each temporary splice with block and a tension dynamometer and the permanent joints are made. An occasional temporary joint is left for final tensioning. Both wires are pulled at the same time.

The auxiliary messenger splice consists of a sleeve in which set screws are applied alternately to the wires at opposing angles. The contact wire splice surrounds the upper portion of the wire and engages the wire grooves. Pins are applied from the top into the wire. Additional grips on the wire are provided by the pins expanding the metal of the wire against the sides of the splice.

After the tension is tested, the remaining splices are made permanent, then the clips which attach the auxiliary messenger to the hangers and the contact wire to the



Outriggers from the Tower Car Permit Working on Catenary Over Tracks Being Used by Steam Trains

auxiliary messenger are applied from the tower cars of a wire train. Outriggers, as illustrated, show the manner in which this kind of work can be done on three tracks with occupation of only one track.

The final operation of catenary erection is the attachment of steadies and pull-offs, testing the alinement of the trolley with that of the track, and making final adjustments.

Power Supply for Electrification

THE three principal sources of power for the Pennsylvania a.c. electrification are connections with the Philadelphia Electric Company's system respectively at Lamokin and Richmond, both near Philadelphia, and a connection with the Pennsylvania's Long Island City Generating Station which also supplies power for the Long Island direct current electrified lines. In addition to these, a contract was entered into for an emergency source of power from the Public Service Electric & Gas Company of New Jersey. Another auxiliary source is available at Arsenal Bridge substation in Philadelphia.

At Lamokin and Richmond, shown on the map, there are frequency converter sets owned by the Philadelphia Electric Company which supply single-phase, 25-cycle, 13,200 volt power to Pennsylvania outdoor type step-up substations. The step-up substations include necessary switching apparatus and transformers which step-up the voltage to 132,000-volt for transmission over the railroad's transmission lines.

The station at Lamokin was placed in service several years ago to supply power for suburban lines in the Philadelphia area. It is equipped with three motor-generator or frequency-converter sets each consisting of a 13,600-volt, 3-phase, 60-cycle, 21,500 hp. motor driving a single-phase, 25-cycle, 13,270-volt, 15,000 kw. 70 per cent power factor generator. The machines are housed with the necessary auxiliary and switching equipment in a brick building. They operate at 300 r.p.m. and are synchronized on both the 3-phase and single-phase ends. The motor fields can be turned through an angle of 24 deg. to provide for this synchronizing and for balance of load between the machines. In the adjoining step-up substation four 15,000 kva. transformers are employed to step-up the frequency converter output to transmission line voltage.

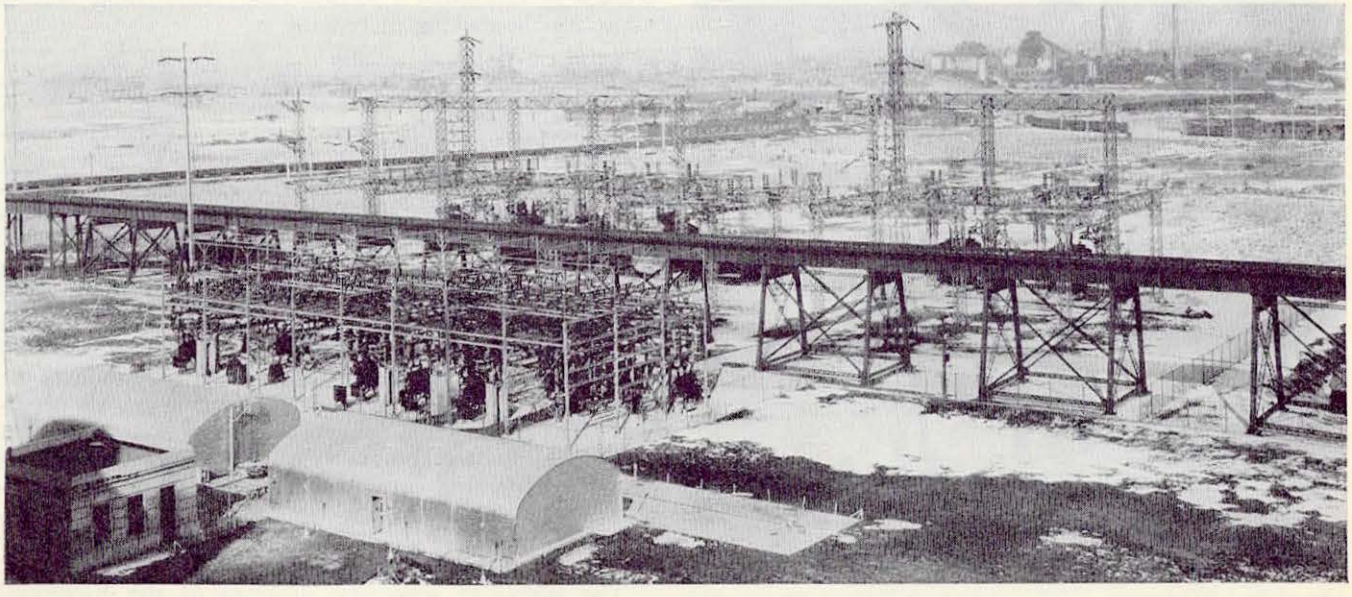
Two of the 20,000 kw. 3-phase, turbo-generator units at the Long Island City generating station are equipped to deliver either three- or single-phase power.

Outdoor Type Converter Station

The station at Richmond was recently placed in operation and its capacity will be increased as the load demand requires. The initial installation at Richmond consists of two 30,000 kw. 70 per cent power factor synchronous indoor-type frequency-converters located outdoors under close-fitting steel-plate housings. A considerable portion of the apparatus is placed within the concrete foundation or basement, which is covered by the arched steel housing. This form of construction represents an appreciable saving in building costs. The ultimate design of the station contemplates a layout of six units ranged end to end in two groups of three each. In the final station a single housing with partitions between units will enclose each group of three machines.

The converters are the largest of their kind ever built. Each set comprises a 36,000 kva., 13,600-volt, 3-phase synchronous motor, directly connected to a 30,000 kw., 70 per cent power factor, 13,200-volt, single-phase, synchronous generator with 200 kw. main exciters and a 7 kw. pilot exciter, all on the same shaft. The generator is equivalent in physical dimensions to a three-phase machine having an output of 61,000 kva. One pilot and four main bearings are required for the complete assembly, the over-all length of each machine is approximately 65 ft. and the weight 1,300,000 lb.

The sets are so designed that they may be assembled



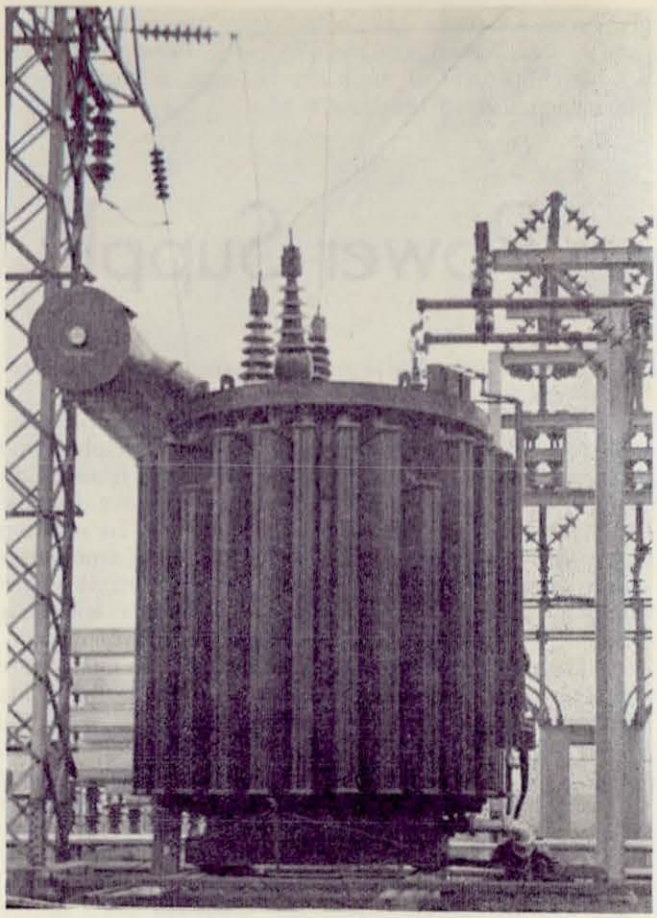
The Richmond Step-Up Station Showing the Steel Plate Housings Over the Frequency-Changing, Motor-Generator Sets

or disassembled within their own length. By shifting the stator of either motor or generator toward the opposite stator, it is possible to expose the entire length of either rotor without removing the inboard bearing of the opposite machine. In this way, either motor or generator may be dismantled for repairs without disturbing the opposite machine. The stator frames may be moved on small rollers inserted on a special roller track by first lifting the frame about one-half inch with screws which perform this function.

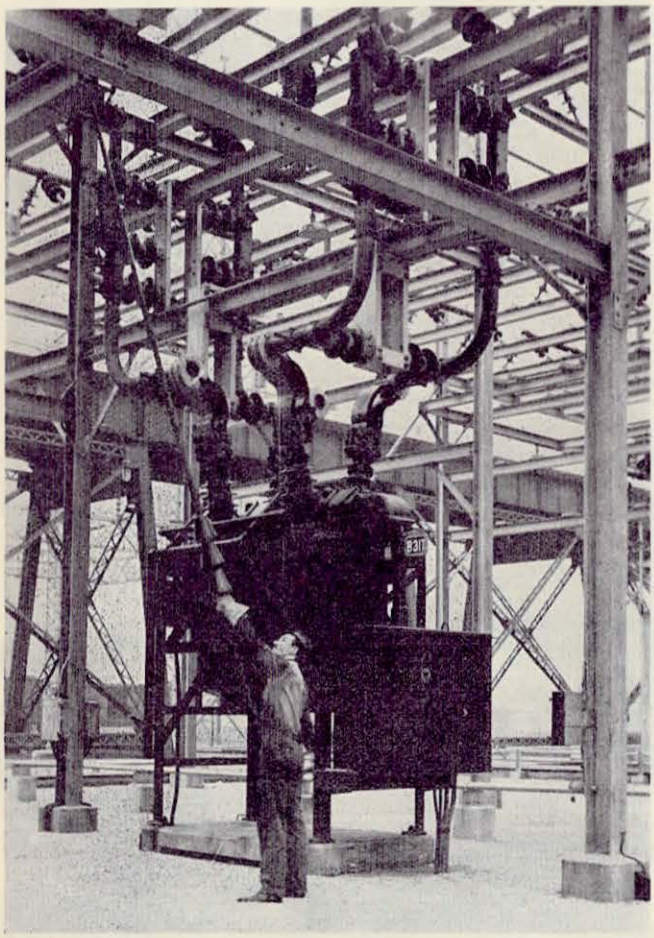
Successful operation of single-phase machines in parallel with those at Lamokin has demonstrated the practicability of parallel operation with third phase windings omitted entirely. The starting motors were selected in place of compensator starting since the first cost is less and the line disturbance at starting is also reduced.

Like the motors employed at Lamokin, the Richmond converter motors have a motor-driven frame shift mechanism. It is arranged to shift the stator 12 degrees each way from the neutral position, or a total of 24 deg. This corresponds to 288 sixty-cycle degrees, 90 of which are required for load control. The remaining 198 deg. may be utilized for synchronizing purposes.

A closed cooling system is used for ventilating the machines. During normal operation at full load air is taken at 40 deg. C., into both motor and generator from a common area beneath the floor plates and discharged at 65 deg. C., from the top of the stators into the area within the housing. The heated air returns to the basement from the housing through water-circulated fin type air coolers. There is a dual cooling water supply and, in the event of cooler failure, raw air may be admitted to the basement of a set through emergency doors



One of the 20,000 kva., 13,200/132,000-Volt Transformers at Richmond



One of the 5,000-Ampere, 13,200-Volt Switches Between the Generator and Transformers at Richmond

permitting indefinite operation as an open system.

With this arrangement of housing, outdoor temperatures are easily transmitted to an idle machine. This might cause the formation of injurious condensation and to prevent this an idle machine is kept warm by circulating through it, heated air from a running machine. For protection against fire, a perforated water pipe is installed in each unit, terminating in a snap coupling outlet outside of the housing adjacent to a fire hydrant. A complete emergency drainage system is provided.

The housings are composed of ¼-in. steel plate shop-welded to fabricated I-section ribs. Removable sectors allow for the making of repairs.

Each converter set requires a foundation 42 ft. wide by 78 ft. long. No integral water proofing was used on the mat or exterior walls, though about 13,000 lb. of 40-oz. copper flashing were used in the various construction joints.

A group of 20 leveling plugs is installed in each machine foundation and vibration, which is always prevalent to some extent in the normal operation of single-phase machines, is reduced to a minimum by springs under the 25-cycle stators. The springs deflect approximately 60 mils under the weight of the stator and about 12 mils under full load torque.

A control building 28 ft. by 33 ft. in plan, houses the switchboards which require the attention of an operator. These include a miniature control board for controlling ultimately the six frequency converters, in addition to switching equipment in the adjoining Pennsylvania step-up station.

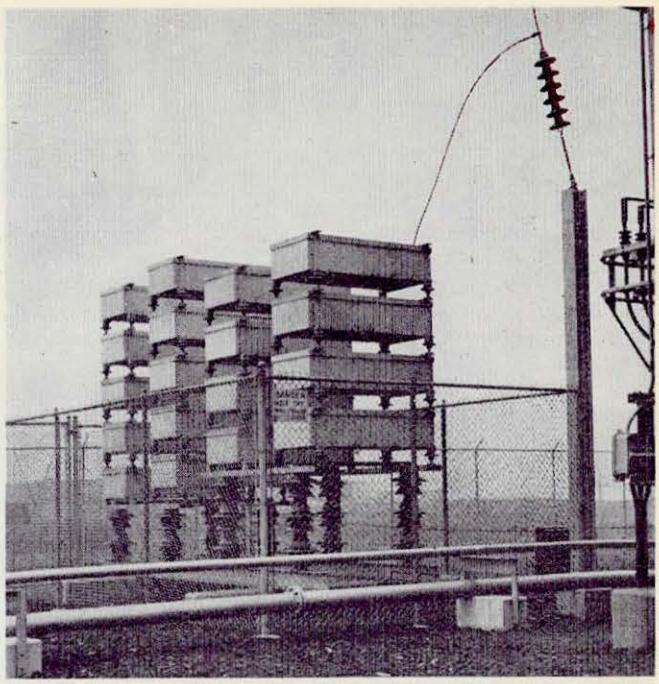
Step-Up Station

The simplified schematic diagram of the Richmond step-up station appears in the section on "Power Super-

vision, Switching and Sectionalizing." It shows the present main power connections from the motor-generator set to the 132,000-volt transmission lines. The 25-cycle leads from the generators to the 13,200-volt bus consist of four 1,750,000 cir. mil paper and lead-covered cables per phase (a total of eight per generator) run in fibre duct. The low side transformer brakers are rated at 5,000 amperes.

The diagram shows six transformers. These are 20,000 kva. units which step the voltage up from 13,200 to 132,000, and there will eventually be 16 such units served by 10 transformer breakers.

The central point of each transformer high voltage winding is connected to ground by a 330-ohm resistance which, in case of a transmission line ground, limits the ground current to 200 amperes. In case of such fault, the current through the ground resistance flows only a short period of time until the low side transformer breaker opens the circuit. It may be seen from the diagram that there are no oil switches on the 132,000-volt side of the transformers. This practice is carried out over the entire system, including both step-up and step-down sub-stations, with the exception of the D1 tie station located at the junction of the Wilmington, Paoli and New York lines. The use of airbreak disconnecting switches in the 132,000-volt circuits, in place of oil circuit breakers, reduces the first cost of transmission and substation structure, considerably reduces maintenance cost, and simplifies the layout of the system. This is expected to increase the reliability of operation by simplifying the details of construction and reducing the number of pieces of apparatus used.



One of the Transformer Neutral Ground Resistances Which Limits the Flow of Current in Case of Fault

Three-Phase Generation

Originally, 25-cycle power for the operation of Pennsylvania trains was generated as three-phase power and converted to two-phase power by Scott-connected transformers. This furnished power at two different phase relations to two sections of the contact system which were not connected with each other and necessitated the use of permanent phase breaks in the contact system. With the present method of power generation, all power is normally supplied on one phase.

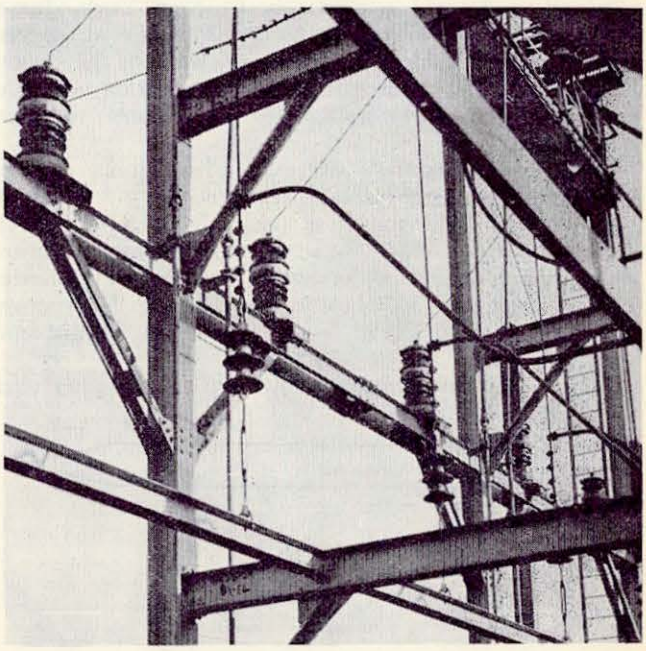
Lightning Protection

PRIMARY lightning protection for the 132,000-volt transmission lines is insured by the ground or static wire run along the tops of the transmission line poles or columns. No transmission line lightning arresters are used except at the D1 substation.

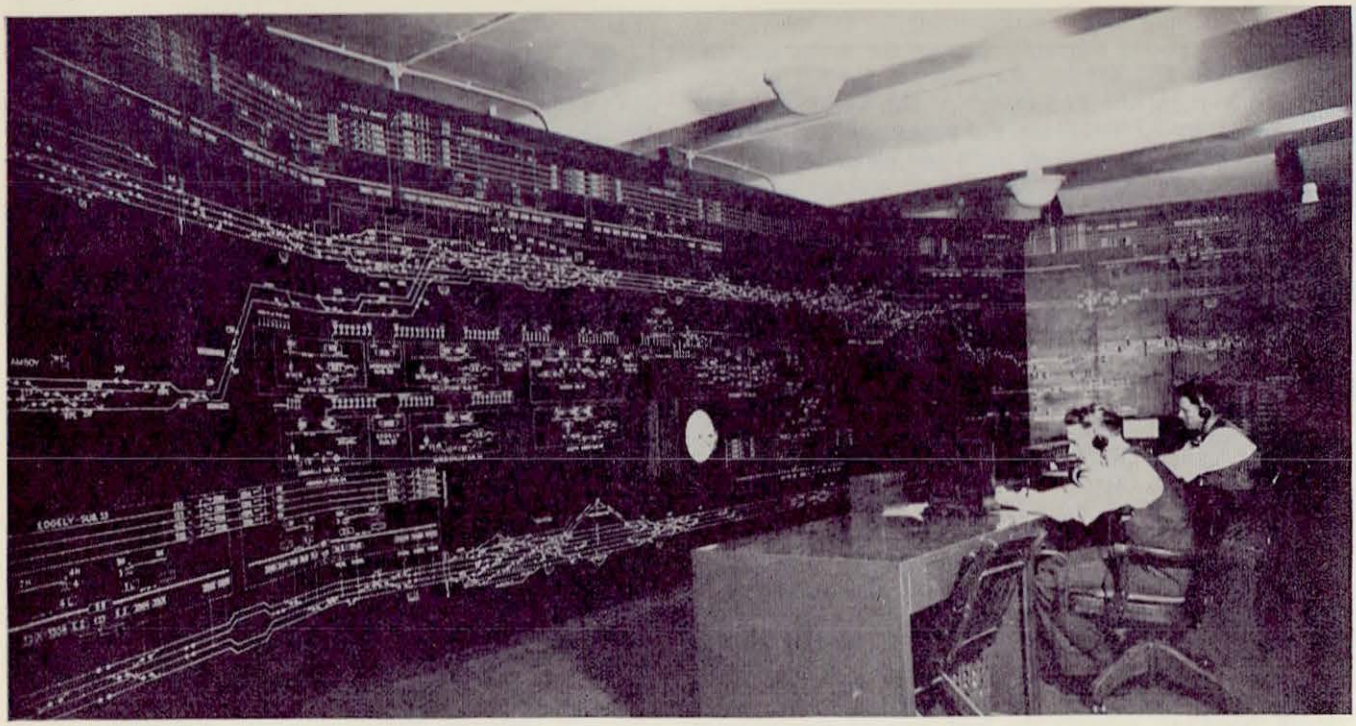
The 132,000-volt circuits at the substations are protected from lightning or high-voltage surges in two ways. At the first pole on either side of the substation, one strain insulator string is reduced to 7 units instead of 13, and arcing or grading rings are placed around the two end units of the string. Any high-voltage surge originating on the transmision line will arc over at this point; the rings serve to protect against insulator breakage caused by flashover. In addition bushings are provided with protective spark gaps. Transformers have 154 kv. class insulation.

Lightning poles are used for protecting the substation. They extend above the substation structure to points high enough to protect all apparatus; each foot in height above the structure serves to protect a circle of three-foot radius. Where possible, the lightning rods are mounted on the same structure which supports lines and switches. The poles are run from the ground when the desired location does not conform with the location of substation structure. Experience thus far has indicated that trouble due to lightning is less frequent on the 132,000-volt line than it is on 44,000-volt lines.

All 11,000-volt circuits are protected at each substation by lightning arresters. One such arrester is connected to each feeder between the high-speed trolley breaker and the catenary wires.



11,000-Volt Lightning Arresters Mounted on Substation Structure



Power Directors Circuit and Switch Indicating Board at Jersey City

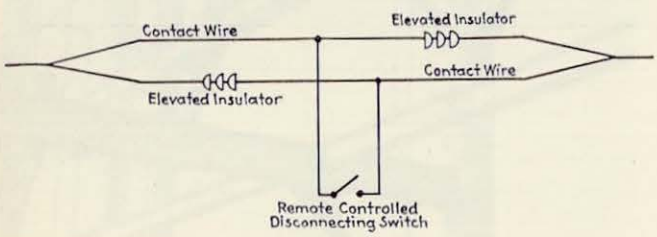
Power Supervision, Switching and Sectionalizing

ALL switches in step-down substations, along the right-of-way and in yards and terminals, are controlled from interlocking towers or stations. Switches in the step-up transformer stations are controlled by the frequency converter operators.

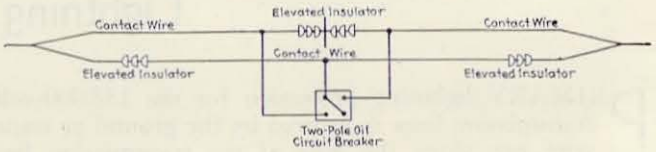
The operation of all switches in the railroad power system is supervised by telephone from three power directors' offices located respectively in New York, Jersey City and Philadelphia. A load dispatcher at present located at New York co-ordinates the work of the various power directors, arranges the load distribution, and contacts with the power companies on matters of major importance.

The power director's office at Philadelphia employs two power directors on each trick or tour of duty with two assistants on the first trick, from 8.00 a.m. to 4.00 p.m. This office supervises switching operations from Philadelphia to Wilmington, Del., to West Chester, Pa., to Paoli, Pa., to Chestnut Hill, Pa., to Norristown, Pa., and toward New York as far as Holmesburg Junction, Pa.

The Jersey City office employs two directors per trick.



Section Break



Phase Break

One director supervises the line from Holmesburg Junction to Rahway, N. J., and the other the section from Rahway to Jersey City, N. J., and to the Hackensack portals or the western end of the Pennsylvania tunnels which run under the Hudson river to Pennsylvania Station, New York City. This includes the direct current operation in the area west of the portals.

The New York office employs one director and one assistant per trick. These men handle all a.c. and d.c. propulsion power in the New York area, the 3-phase, 25-cycle a.c. power from the Long Island City power plant and the 3-phase, 60-cycle a.c. power for local building demand.

The directors also arrange for switching operations and clear with the operators in the converter stations when it is necessary to perform switching operations in the step-up substations. In each of the power director's offices is a large circuit and switch-indicating board. The main power circuits are shown in the diagram on these boards. In some cases the open or closed position of each switch is indicated by removing or placing a wooden plug in a hole drilled in the board at the location of the switch on the wiring diagram. The latest type of indicating board employs small lights instead of holes and plugs at

the switch locations. These lights are controlled by a small bench board located between the two operators' desks. On this bench board there is a button or switch which controls each indicating light, and when a power switch is opened or closed the director records the position of the switch by turning the light on or off.

Orders for opening or closing any of the power switches are given by the power director over the telephone to the operators in the interlocking towers. The telephones used are of the coded ringing type and the power director has one key for each interlocking location. Operation of this key sets up the code for one particular location and rings the telephone in a period of eight seconds. After the order for switch operation is given, it is performed and the interlocking operator reports back to the power director who then marks the new position of the switch or switches on the indicating board.

Switching and Sectionalizing

The general plan for control of all circuits may be understood by consideration of the four diagrams showing respectively a typical step-down substation, the Richmond step-up station, the section break and the phase break.

The section breaks located in the line at positions remote from interlockings are the same as those used in the main line tracks at interlockings, except that the break is normally by-passed by a remote controlled disconnecting switch mounted on one of the H-section poles at the section break. The two lines are separated in the same way as they are at interlockings. The wires from opposite directions are carried past each other without touching, the end of each being lifted at a slight angle to an insulator so that a passing pantograph slides off of one wire and onto the other, contacting with both for a distance of about 20 feet. When a section of line between two such section breaks is disconnected, the disconnecting switch at the section break or the high-speed breaker in the substation on each end is opened and the power director reports the condition to the train dispatcher who then keeps trains off this section of track and away from section breaks so that a pantograph may not span the break and energize the dead section.

In case of a short circuit or ground fault on any one of the four catenary lines over the tracks, the section between substations is automatically disconnected by the high-speed trolley breakers feeding that section. Assume for example there is a short circuit on the catenary wire T3 as shown in the typical substation wiring diagram. The high-speed trolley breaker B9 will open and the corresponding breaker in the next substation will also open. Many times the cause of such a short circuit is momentary, and at the discretion of the power director one of the high-speed trolley breakers may be reclosed to attempt to energize that section of catenary. If the fault persists, the breakers are allowed to remain open and the tower operator places a card on the control switch to show that it is to remain in this position until orders are received for its reclosing. Steps are then taken to clear the fault and in the meantime trains are routed over another section of track. Section breaks between substations reduce the amount of track held out of service for repair purposes to that between

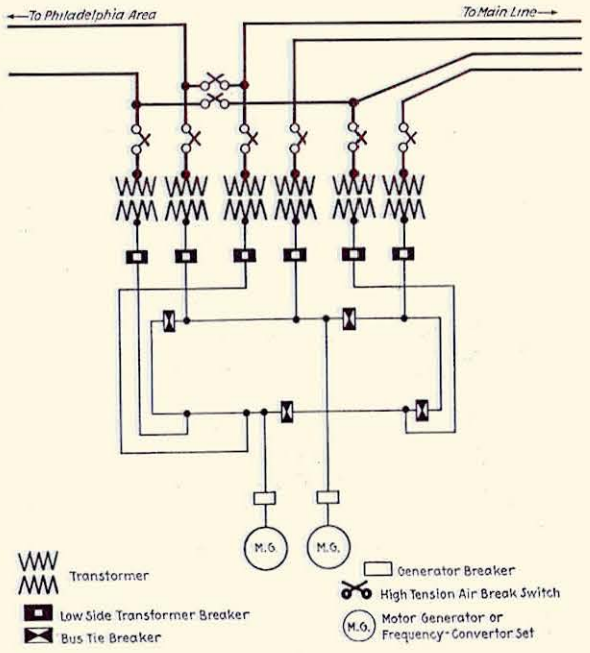


Diagram of Power Circuits at the Richmond Step-Up Station

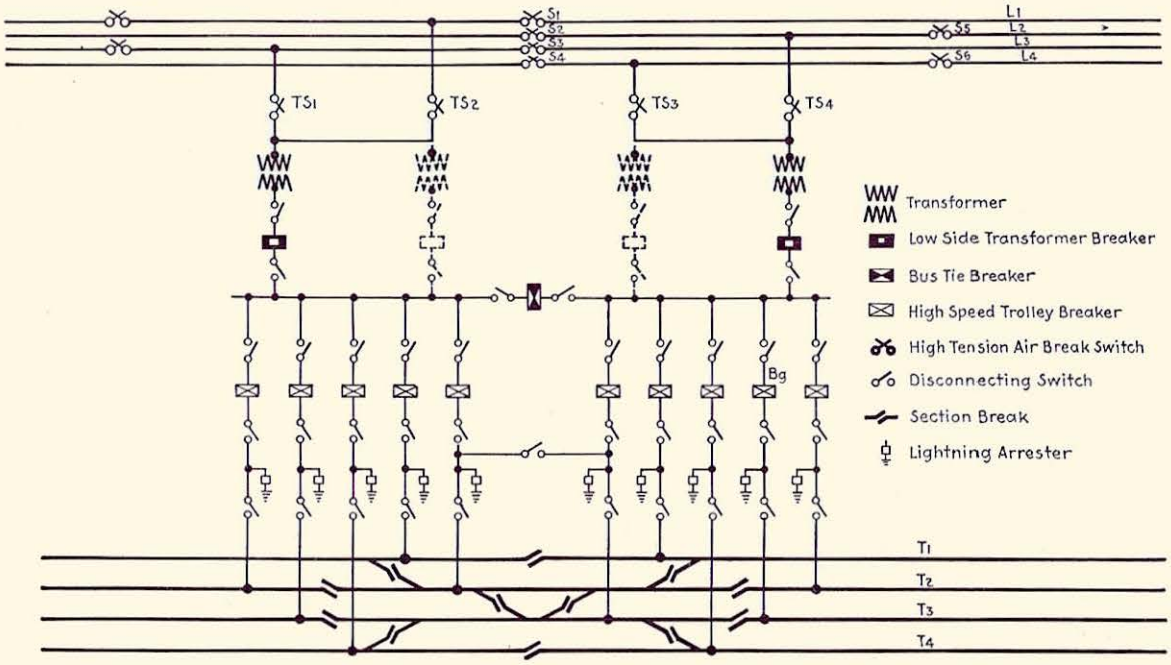
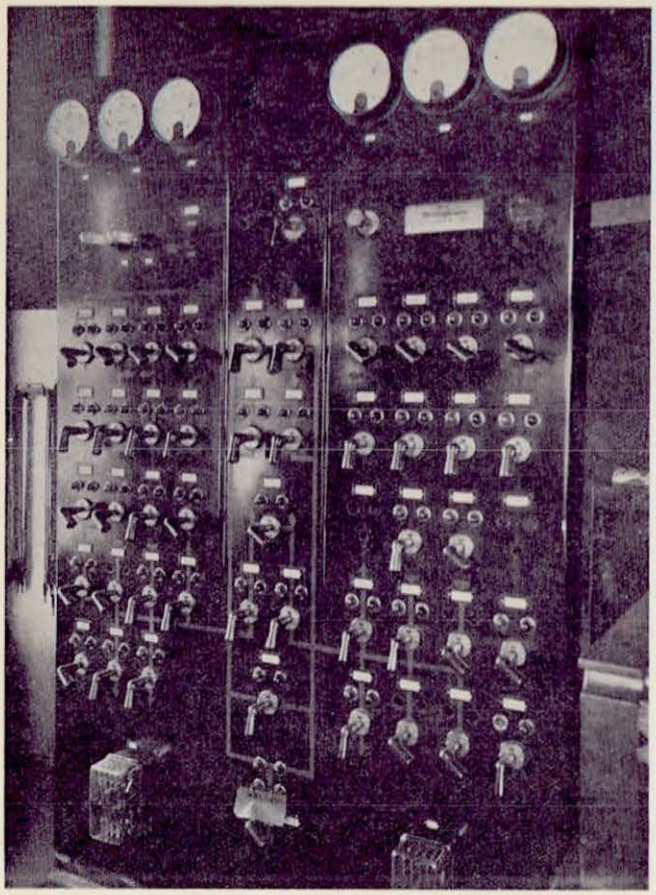


Diagram of Power Circuits for One of the Step-Down Substations



Power Switch Control Board in an Interlocking Tower

two section breaks or between a substation and a section break; they also facilitate locating troubles to small sections.

A short circuit or ground fault on any one transmission line will open the 13,200-volt transformer breakers, in the primary of all transformers in step-up substations feeding that line. It will also open the low side transformer breaker in each step-down substation on the transformers connected to the faulty line. To isolate the particular section of transmission line in trouble, the line may be divided at each substation by the high tension air break switches S-1, 2, 3 or 4. These switches may be opened on line charging or transformer excitation current, but are not designed for disconnecting load or fault current.

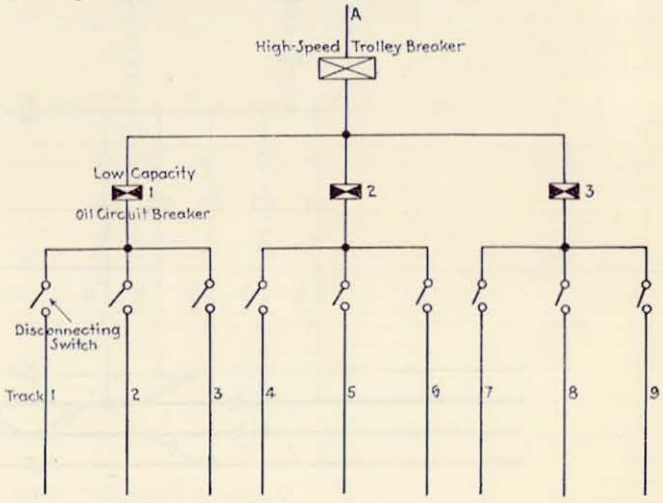
If the location of the fault is not known, it may be determined by energizing one section of transmission line at a time either from one of the step-up substations or from the 11,000-volt bus through the step-down substation transformer connected to that line. Power is supplied to most of the substations from both directions and when such is the case, the line fault means only the temporary elimination of a section of transmission line between two substations and no loss of transformer capacity.

The transformer high tension airbreak switches TS1, 2, 3 and 4, shown in the typical substation diagram, are remote manually operated, except in case of a transformer fault. A transformer fault will disconnect the line feeding that transformer and will also open the low side transformer breaker. In such a case, a relay functions to open the transformer high tension airbreak switch automatically after the low side transformer breaker has opened. The same type of switch operation is used for transformer protection in the step-up substations.

No 132,000-volt oil switches are at present used in any of the transmission lines except at the D1 step-down substation. At this point oil switches provide means of disconnecting under load, the transmission lines which are fed from the New York and Richmond power sources from the lines which are fed from Lamokin and which extend to Wilmington, Norristown, West Chester, and Paoli and serve the Philadelphia area. Phase breaks are placed in the catenary system at points between step-up stations to allow for the possibility of generating stations being out of step or synchronism. The phase breaks differ from the section breaks in that the catenaries from opposite directions do not pass. Instead of this a third piece of catenary or contact wire is run parallel to the two dead-ended sections. This overlapping section of wire is not in contact with the catenary section in either direction but is connected to them through an oil circuit breaker. A two-pole breaker is used for this purpose; each pole connecting the parallel or overlapping section to the contact system on either side of the phase break. In case it is necessary to open the phase break, a circle of lights indicates to the engineman that the break is open and that he must shut off power and coast over the break.

In yards and at terminals where it is necessary to feed contact wires over a number of tracks, a type of switch control has been devised which automatically isolates and indicates the location of a fault and accomplishes this result with a minimum amount of expensive switch gear. The arrangement as applied to nine tracks is shown in the diagram "Switching Control for Yard or Station Tracks." Power is supplied from A through a single high-speed trolley breaker to three low-capacity oil circuit breakers. The three oil circuit breakers in turn each feed the contact wire over three tracks through air break disconnecting switches. Should a short, ground or overload, occur on track No. 1, the high speed trolley breaker would open, this operation requiring about one twenty-fifth of a second. During this period of time a relay functions to determine the location of the fault. After the high-speed trolley breaker has opened, the low capacity breaker, feeding tracks No. 1, 2, and 3, opens and the high-speed trolley breaker recloses. A light indication on the control board shows that the fault lies on track No. 1. The operator may then open disconnecting switch No. 1 and reclose the low capacity breaker to re-energize tracks 2 and 3.

In the terminals it was considered that the possible opening of a disconnecting switch under load current would be objectionable and to avoid this these switches are so interlocked that the operator cannot open them when power current is flowing in the line.



Switching Control for Yard or Station Tracks

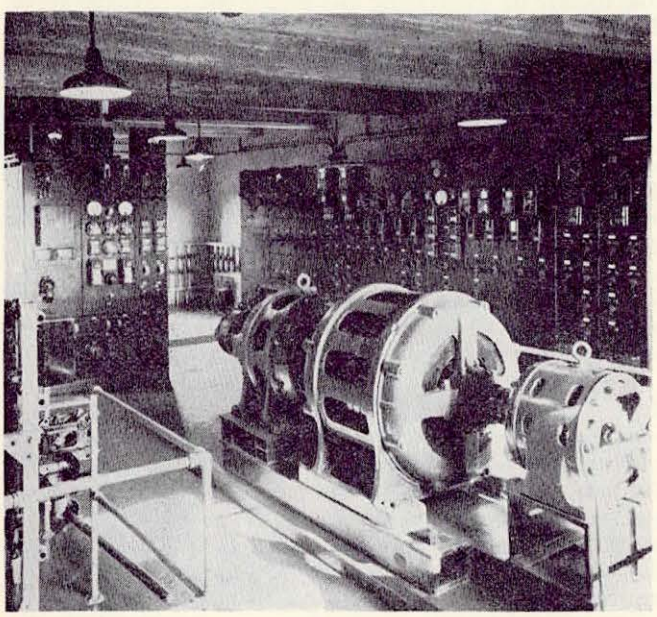
Changes in Interlockings and Signaling System

THE change-over from steam to electric propulsion necessitated a complete reconstruction of the signaling system. West of Newark the wayside signals of the semaphore type on signal bridges were replaced with position-light signals which, except at interlockings, are mounted on new bridges which form a part of the "H" catenary structure. At interlockings the signals are mounted on heavy anchor-type bridges which act as anchors for the trolley system. West of Newark the signals were relocated to afford proper spacing for train speeds of 75 m. p. h. with two-block indication, while train speeds up to 90 m. p. h. can be accommodated merely by changing to three-block indication.

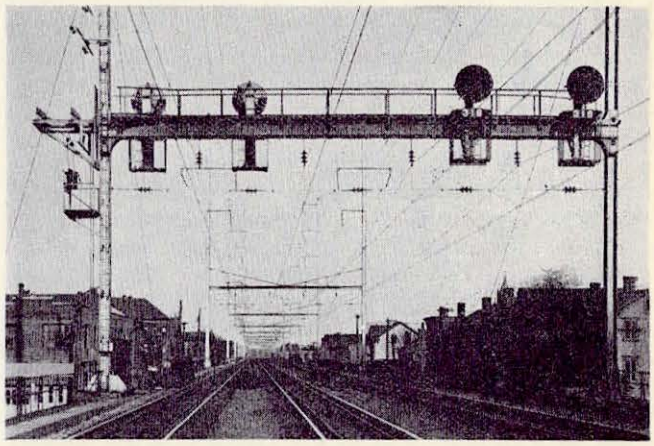
In the tunnels under the East river and the Hudson river, as well as in the Pennsylvania terminal, the color-light signals formerly in service were retained. Both of the two main tracks from the Pennsylvania terminal through the Hudson river tunnels and over the Meadows High Line to Manhattan Transfer are signaled for train operation in either direction. Reverse running with lock and block protection is provided for the tracks in the Pennsylvania terminal and through the East river tunnels.

As a part of the new signaling system, continuous coded cab-signaling was installed in all the electrified territory with the exception of the tracks in the terminals at New York and Jersey City. Locomotives and multiple-unit cars are equipped with cab signaling, including whistle and acknowledger. The cab signal indications are, caution-slow speed, approach, approach-restricting, and clear.

The automatic train stop system of the tripper type formerly used in the tunnels at New York will be retained for the control of the Long Island equipment. These tripper stops are controlled by track circuits with a full block overlap, and, when in the stop position, effect an emergency application of the brakes.



Interior of Substation Control Building Showing Signal and Power Switch Control Panels and Motor-Generator Set for Signal Power Supply



Beam-Type Signal Bridge—An Anchor Type of Signal Bridge is Shown in the Section "Locating and Erecting Catenary Supporting Structures"

Interlocking Reconstruction

The respacing of the signals and the introduction of the 100-cycle track circuits and the coder cab signaling, necessitated numerous changes at the 26 interlockings in this territory. Of these plants, 18 are electro-pneumatic 4 electro-mechanical, 3 mechanical and 1 all-electric; a total of 1,053 working levers being involved.

The a.c. electrification necessitated the installation of trolley wires at three draw spans in the New York area; two of these plants are of the swing-span type and one the lift-span type. At each of these bridges the interlocking circuits are arranged to insure that the trolley will not interfere with the opening of the bridge, and that the trolley is in place and rails are locked before the signals can be cleared.

100-Cycle for the Signaling

As the propulsion current is 25-cycle, it was necessary to use a different frequency for the signal track circuits to prevent any interference. Therefore, 100-cycle current was adopted for the track circuits which, of course necessitated an entire new 100-cycle power system for the signaling, separate and apart from the propulsion power system.

Centrifugal frequency relays are used on all track circuits with the exception of the short ones at interlockings or on sidings, where single-element frequency vane-type relays are used. An important feature of the signaling was the installation of impedance bonds, the function of which is to terminate the 100-cycle track circuit at each signal location, but to continue on to the next block the rail circuit for the 25-cycle traction current.

On the territory from Newark west through Philadelphia to Wilmington and Paoli, only 25-cycle propulsion current is used, the signaling power system being 100-cycle and all track circuits are of the double-rail end-feed type, using impedance bonds of 200 amp. per rail capacity, with a 4-ohm bond at the feed end and a 1-ohm bond at the relay end.

On the territory between Manhattan Transfer and Sunnyside yard, including the New York terminal, as well as between Jersey City and Manhattan Transfer, the 25-cycle propulsion system is superimposed on the previous d.c. propulsion system so that these tracks can be used by the new 25-cycle equipment, as well as by the d.c. equipment of the Long Island between the terminal and Sunnyside, and by the d.c. equipment of the Hudson & Manhattan between Jersey City, Manhattan Transfer and Park Place, Newark. In this a.c.-d.c. territory the signal power is 91.6 cycle so as to avoid interference with the 100-cycle of harmonics of the 25-cycle propulsion current, resulting from the dual a.c.-d.c. operation in this section. The cab signaling equipment is arranged to operate efficiently on either 91.6 cycles or 100 cycles.

In the Pennsylvania terminal area most of the track circuits are single rail. Departure test loops automatically give the required cycle of cab signal indications before trains leave for their destination. Similar test loops will be used at Sunnyside yard, Jersey City terminal, Henderson street, Park Place, Journal Square, Manhattan Transfer, Millstone and Trenton. In the a.c.-d.c. territory the impedance bonds are rated at 1,500 and 2,500 amp. per rail to take care of the heavy d.c. loads. These bonds have an impedance at 100 cycles of approximately 0.5 ohm.

To provide the maximum power rail return with the least reduction of broken-rail track circuit protection, a careful layout of cross-bonding was required. To insure maximum broken rail protection of coded track circuits in automatic signal territory, the circuits are so arranged that when a train enters the block and a "V" relay is de-energized by the shunting of the track relay the track voltage and local track relay voltages are automatically reduced by an auto-transformer from 110 volts to 85 volts for the primary side of the track transformer, and from 110 volts to 52.5 volts for the local element of the track relay. It is a characteristic of the centrifugal relay that it will operate on low track voltage provided the local voltage also is lowered. The higher values are required, however, to insure the proper braking effect needed for quick release of the instrument when shunted. The scheme permits correct track circuit values for both relay and coded circuits.

The bonds on the rail joints which are, of course, used jointly by the propulsion and the track circuit currents, are explained elsewhere in this series of articles. The connections from the rails extending to the track transformers and relays are in No. 6 stranded parkway cable buried in the ballast, no conduit being used. At the rail the parkway conductor is connected to the pin-type track wires by connectors, this connection being placed in the bootleg riser.

The low-voltage control circuits between automatic signals are in lead-covered cable run underground in duct. As a rule this cable is 30-conductor No. 14 with two No. 4 core wires. Parkway cable was used from the nearest manhole to the instrument case on each signal bridge. At interlockings the lead-covered cable is 61-conductors in most cases. Where new construction was not involved, the cables were run in existing wooden conduit, but otherwise the lead cables were run in fibre conduit to terminal locations, from which point parkway cable extends to various switch and signal units. The fibre duct is buried 3 ft. below the surface of the ground and is incased in concrete.

In automatic territory, wooden instrument cases are mounted adjacent to the signal bridges on concrete foundations, while at interlockings the cases are mounted on the signal bridges. The cases in the Hudson and East River tunnels are made of copper bearing steel and Allegheny metal.

Duct Line Construction

On certain sections of the territory now electrified the telephone and signal circuits were previously carried on line wires. The pole line originally consisted, in some locations, of six 10-pin arms along one pole line and, in other locations, of three arms on each of two pole lines, one of which was on either side of the right-of-way. It was felt that these aerial wires would not only be a hazard, but would be subject to excessive interference from the normal induction to be expected incident to the electrification. The relatively large number of additional circuits required for electrification purposes, together with the telegraph circuits previously superimposed on telephone circuits which would operate satisfactorily only on the basis of full metallic operation, led to the selection of lead-covered cable as the only satisfactory method of economically obtaining the desired safety.

As an example of this construction, the following explanation applies to the 18 miles of six-duct conduit installed between Liddonfield and Trenton, which consists of 2 by 3 multiple tile laid three wide and two high

An Impedance Bond

on creosoted plank with the top and sides encased in concrete. The conduit was laid in this manner with the thought that ultimately 9 ducts in a 3 by 3 formation would be required; such an arrangement is now attainable merely by excavating and laying the additional three ducts on top of the present ones. The majority of the manholes were cast in place. The Pennsylvania overhanging type of manhole frame and cover was used in all cases where surface traffic was not encountered.

The conduit was located so that the manholes were approximately in line with the catenary poles, this being done because there was less probability of future track installations blocking the manholes in this location. The maximum distance between manholes is 500 ft. so that a single 510-ft. length of cable will serve as a replacement length for the maximum section, thereby eliminating the necessity of maintaining a stock of odd lengths for replacement in the event of a cable failure.

A special type of I-beam conduit was used to carry the duct across streets and streams where the clear span was less than 70 ft. This type of construction places a conduit in vertical formation on each side of the web and the entire formation is incased in concrete. This construction permits the duct to be supported only at the piers on either end and, because it is not connected to the bridge or track structure, the vibration is reduced to a minimum. In two or three instances messenger is used to support cables carried across streets where the clear span is in excess of 70 ft. The messenger and cable are protected against any falling wires by a shield

made of galvanized-iron 2-in. mesh, supported by a frame.

Signal Power Supply

The 6,600-volt 100-cycle signal power line consists of two No. 0 seven-strand bare copper conductors strung on pin-type insulators mounted on single crossarms bolted to the catenary poles 10 ft. below the 132,000-volt 25-cycle power transmission line. The signal line is transposed every 3.5 miles. The 100-cycle signal power is supplied from 75-kva. motor-generator sets located at various points along the line. For example, between Newark and Trenton, one motor-generator is located at Morrisville, Princeton Junction, Millstone Junction, Rahway and Kearny. At the first three points mentioned, a single-phase induction motor is used, taking power from the 25-cycle propulsion power system. At the two other points, three-phase motors are used, the power being taken from a commercial supply or other Pennsylvania Railroad lines.

The 100-cycle current is generated at 440 volts, which is transformed up to 6,600 volts for the line transmission. This line voltage is transformed to 110 volts at the signal locations, a 3 kva. 6,600 110-volt transformer being used at each automatic signal bridge and a 5 kva. transformer at each home signal bridge at an interlocking. The 110-volt secondary circuits are so arranged that the load may be sectionalized from one transformer to the other, or each transformer segregated for certain portions of an interlocking.

Manually-operated air-break switches at each signal bridge are used to sectionalize the 6,600-volt line when desired. The line transformers are protected with 7,000-9,000-volt lightning arresters and are fused at 3 amp. on the primary side. The secondary windings of the 3 kva. transformers are fused at 30 amp. and the 5 kva. transformers at 60 amp.

Automatic switching is provided to switch the line load between the different substations mentioned above. Power is supplied normally from Morrisville east to Princeton Junction; from Millstone west to Princeton Junction and east to Rahway; from Kearny west to Rahway.

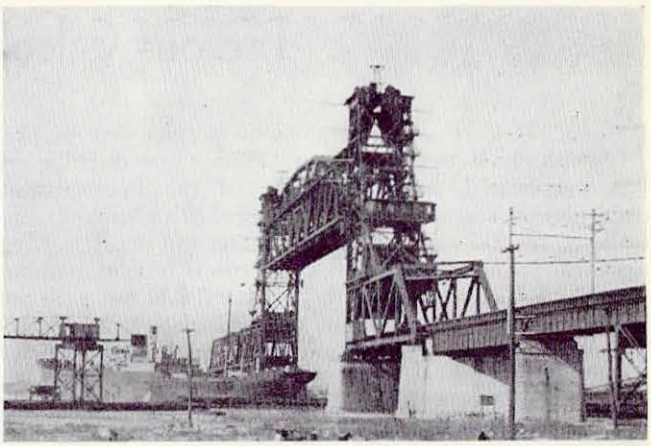
If power should fail at Morrisville or Millstone, then Princeton Junction cuts through immediately and the machine at Princeton Junction automatically is started for standby service and will feed to Morrisville and Millstone in case the power fails at both Morrisville and Millstone. In case of power failure from Millstone east or Kearny west, the machine at Rahway cuts through at once and the machine at Rahway automatically is started for standby service and will feed to Kearny and Millstone in case of failure at both Millstone and Kearny. Each machine locks out in case of over current or under voltage and service must be restored by manual operation. The same general scheme of power supply for signaling employed in the Newark-Trenton section is also used for the other territories involved in the electrification project.

Soft Trolley For Movable Railway Bridges

TO avoid arcing at hard spots where trolleys pass over movable railway bridges, means have been developed for providing a soft or flexible trolley at the breaks in the bridge. The Hackensack river bridge, shown in the illustration is so equipped.

The method used is to provide a sort of traveling phase break, as shown in the diagram. The vertical dotted lines represent the ends of the lift span and the solid lines show the trolley wires. The shore ends of the trolleys *A* and *H* are dead-ended, respectively, at *B* and *I*. The circuits are continued through wiping contacts to short dead-ended sections *OP* and *QR* and through similar contacts to the trolleys D and K on the lift span which are dead-ended respectively at *C* and *E* and *J* and *L*. This construction and operation is duplicated at the other end of the lift span.

The trolley sections *OP* and *QR* are mounted on a traveler actuated through ropes, drums and gears attached to the bridge counterweight. As the bridge starts to rise, the travelers at each end of the bridge move back over the shore ends of the bridge as shown by the horizontal dotted lines. They travel at twice the rate at which the span rises and will thus clear before the span reaches the trolley level. The travelers are 80 ft. long and travel a distance of 46 ft. They may be operated by hand in case the mechanism fails to function properly.



Hackensack River Lift Bridge Equipped with Traveling Trolley Sections

This arrangement avoids contact of the pantographs

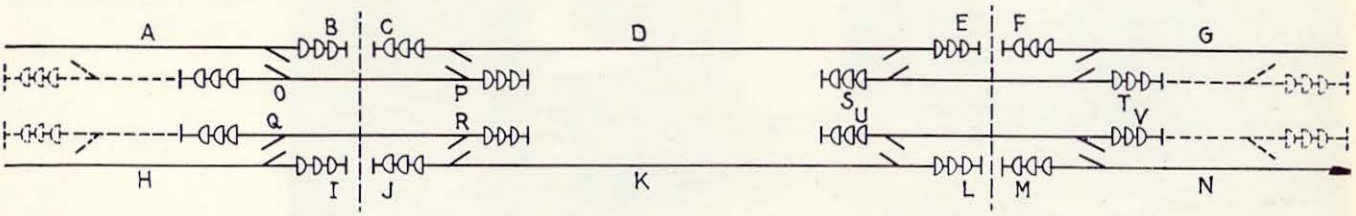


Diagram of Catenary Circuits on Lift Bridge—Diagonal Lines Indicate Wiping Contacts

with any rigid members since it slides from one suspended wire to another as the locomotive or multiple-unit car crosses the bridge. In addition to the bridge trolleys described, connections are also carried overhead above the maximum lift of the bridge so that no circuit is opened when the bridge is raised.

Inductive Co-ordination

THE inductive coordination of the electrification circuits with commercial and private communication systems, as in the past, has been handled through cooperation with the commercial telephone and telegraph companies and the railroad's telephone and telegraph, signal and electrical departments. This cooperative work was undertaken at an early stage in the development of the design of the electrification system, hence it was possible to carry out the tests necessary for planning measures of coordination well in advance of electrical construction. Using portable testing apparatus developed especially for the purpose, testing of this kind was carried on over the entire section between Philadelphia and New York and between Philadelphia and Norristown.

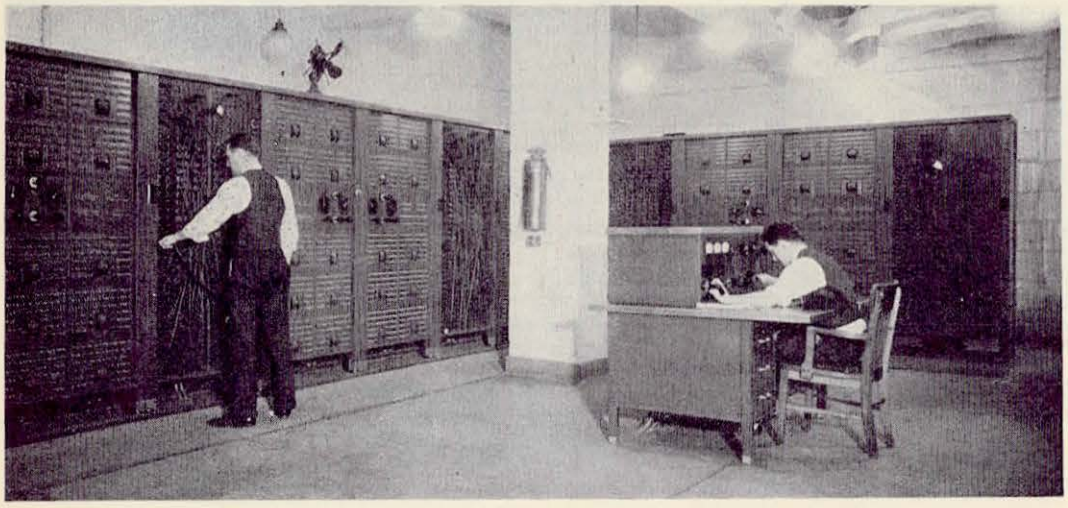
The standards of construction adhered to on this electrification and certain features of the design simplify, to a considerable extent, the problem of inductive coordination. The most outstanding of these features are: (a) rugged construction and ample insulation of the overhead system, which reduce the frequency of occurrence of short circuits; (b) the use of high-speed circuit breakers in trolley feeders, which limits the duration of short-circuit currents; (c) thorough bonding of rail joints and the use of high conductivity ground wires on the transmission lines, which reduce the current escaping from the return system to earth; and (d) avoidance of stub-end feeds, thus limiting the inductive effect of load currents.

The communication facilities of the Pennsylvania Railroad between Philadelphia and New York are largely in underground cable. The sheaths of these cables afford a certain shielding effect against induced voltages. To provide additional shielding a 4/0 copper wire was placed in a spare duct throughout the entire section and bonded to the rail return system. A reduction in 25-cycle induced voltage of approximately 50 per cent has been secured by this shield wire. On the Schuylkill division the communication circuits are largely in aerial cable on the railroad right-of-way. The sheath of this cable is encased in tape armor and two 4/0 copper shield wires are carried on poles which support the cable. The combined effect of the tape armor and the shield wires reduces the 25-cycle induction in these circuits about 65 per cent.

Operating experience along the sections which have been in electrical operation for some time has shown that, in general, coordination of the two services has been satisfactory. On the basis of this experience and on the basis of the preliminary studies and tests, similar results are expected on the sections recently electrified.

Tedious Calculations Made Easy

ELECTRICAL characteristics of circuits may be predetermined by calculation. When the circuits are complicated, as is the case of the Pennsylvania transmission and distribution system with its many substations, several power supply stations and many moving electrical loads, the required calculations become tedious. An a. c. calculating board purchased by the railroad has practically eliminated all such calculations. On this board, the values of resistance, inductance and capacity to be found in practice are set up in miniature and corresponding miniature values of voltage or current with suitable frequency and phase relationships are applied to the circuits set up. With conditions thus established on the main switchboard shown in the illustration, meters on the desk or control board can be inserted in or connected to any desired part of the circuit to show what the value of current, voltage, or phase angle is at any point under a given set of conditions.



The Calculating Board in Pennsylvania Station, New York City

The measurements include fault conditions; this is particularly important in predetermining the proper sequence of relay operations. The board can also be used for a variety of other kinds of calculations such as to determine division of load between the several power sources, how much of a transmission line disturbance can obtain before the generators at the power plants will fall out of step, etc.

Concentric Cables

SINGLE-phase power connection between the Long Island City power plant and the Hackensack portal is made through the East river and Hudson river tunnels by concentric cables. These also provide feeders to the Sunnyside yard and Pennsylvania station areas.

Power is generated at Long Island City at 11,000-volts and one-to-one ratio transformers connect the generators with the cables. These transformers serve to keep the rail ground off the power plant generators. At the Hackensack portal the 11,000-volt cables are connected through 11,000/132,000-volt transformers to the transmission lines.

A cable consists of a central 1,250,000 c.m. conductor made up of ninety-one .1174-in. bare copper wires insulated with 21/64-in. paper insulation. Around this insulation is stranded the outer conductor, consisting of thirty-two .1985-in. bare copper wires. Over the outer conductor is placed 7/64-in. paper insulation, and a 5/32-in. lead sheath. The outer conductor is connected to the rail at specific locations. There are three cables under the East river and four under the Hudson river.

Concentric cable has been used previously for low-voltage distribution circuits but the cable used in the tunnels was developed especially for the Pennsylvania 11,000-volt service. As compared with two-conductor cable, or two single-conductor cables, the cost and size of both cable and conductor are greatly reduced. The concentric cable also serves materially to reduce inductive losses.

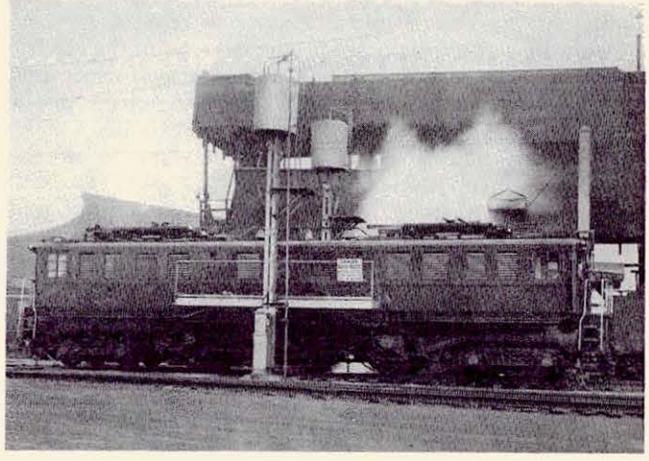
Modern Electric Equipment Repair Facilities

THE major changes in maintenance facilities brought about by the through and suburban electrification of the Pennsylvania were made at Wilmington, Del., where complete shop facilities have been provided for the heavy repair of the electric locomotives and the multiple-unit suburban cars. In addition, oil, water and sanding stations have been added at the different electrification terminals. An inspection shed at Paoli for the making of routine periodic inspections of the multiple-unit equipment is retained.

The electric locomotive repair facilities at Wilmington are housed in the steam locomotive erecting shop at that point, which for many years has handled all back-shop repairs of the steam power operated at that point. With the coming of electrification, this shop has been undergoing major changes in order that it might be used for making heavy repair to electric locomotives and to such steam power as remains in service. Eventually, it is expected that the shop will be used almost entirely for electric locomotive repairs.

At present, the electric locomotive repair facilities occupy less than one-half of the main longitudinal erecting bay of the shop, and about two-thirds of one of the main auxiliary bays of the shop, the latter space being approximately 300 ft. long by 60 ft. wide. A new wood block floor has been laid in this latter area and the shop has been painted with aluminum paint to improve its general appearance and lighting conditions.

While limited in size at the present time, the electric locomotive repair shop is equipped for handling all classes of repairs, including those to motors, transformers, boilers, frames, trucks and wheels. The electric motor repair section is equipped for the complete dismantling of motors and transformers, for rewinding armatures and fields, for all classes of commutator work, and for the manufacture of pantograph shoes. Some of the more important shop equipment includes two racks for supporting and rotating motors while being dismantled or assembled; a commutator turning machine; a commutator slotting machine; a lathe for banding armatures; six stator racks; a 200-ton press for removing or applying the stator bushings in which the fields of the motors are assembled; a machine for seasoning or hardening commutator surfaces to increase their life; a testing transformer to permit a high potential test of all electrical parts; a large cleaning tank for cleaning electrical parts; two large dipping tanks and two baking ovens for the proper treatment of motor and transformer windings with insulating varnish; and suitable machines for the stamping, punching and forming of pantograph shoes. To facilitate the handling of the electrical equipment being repaired, the erecting shop is fitted with two 100-ton and one 15-ton traveling cranes, and the electric motor repair section has two 15-ton cranes.



One of the New Locomotives Ready to be Serviced at the Water, Oil and Sand Station at Wilmington, Del.

General View Through the Electric Locomotive Motor Repair Shop at Wilmington, Del.

Major repairs are handled progressively through the shop and are timed to produce the most effective output. While repairs are being made in the erecting shop to a locomotive proper, or to its mechanical equipment, electrical repairs proceed in the electric motor repair shop. Motors requiring repairs are transferred to the motor shop where here they are put on the dismantling rack, and their armatures are removed. The armatures are then taken to a lathe where they are turned and slotted, or rewound, if necessary, and then go to the ovens for heating prior to being dipped and baked. Following preheating, the armatures are sent to the dipping tanks, where they are immersed in an insulating varnish, and they are then baked to afford the varnish suitable hardening treatment. From the ovens they are taken to the assembly rack where they are installed in their motors, the other parts of which have been gone over and repaired, if necessary, while the armature work was under way. Thus overhauled and reassembled, the motors are ready to be reinstalled in the locomotive from which they were removed.

Other Shop and Terminal Facilities

All class repairs to the motor units of the multiple-unit suburban equipment are made at the large car shop at Wilmington, where special facilities have been added to permit the complete overhauling of the electrical equipment as well as the cars themselves. To do this work, an extension, approximately 300 ft. long by 200 ft. wide, was made to the existing car shop, and is thoroughly equipped to permit all classes of repairs.

Operations at the shop are progressive, as in the electric locomotive shop, so that while motor, transformer and other electrical equipment repairs are being made in the electrical repair section, car repairs, including body, truck, wheel and upholstery work, are made in the mechanical repair section.

Periodic or mileage inspections of the multiple-unit equipment are made at Paoli, where there is an inspection shed, 400 ft. long by 150 ft. wide. This shed, which is of brick construction, with large glazed wall areas, a truss roof and a concrete floor, has five through pit tracks and all equipment necessary for the inspections and minor repairs made at this point.

To meet the requirements of the new electric locomotives for sand, and for water and oil for the operation of their oil-fired coach heating boilers, it was necessary to establish new sand, water and oil stations at the various electrification terminals. Typical of these stations is the one at Wilmington, shown in one of the illustrations.

This plant consists essentially of two sand towers, one on each side of a service track, with water and oil feed outlets also on both sides of the track, so that locomotives can be serviced regardless of the way they are turned. The sanding towers, which are approximately 30 ft. high, consist essentially of a six-ton dry sand drum, supported on a structural steel column, which feeds the sand to the storage boxes of the locomotives by gravity. The elevated supply drums are kept filled with dry sand by air, the sand having been dried previously in the sand dryer.

At Wilmington, the dry sand is furnished by the old sanding plant constructed and operated in conjunction with the steam locomotive coaling trestle at that point. This same arrangement, using existing sand drying facilities, is followed at certain other points. Loading of the locomotive sand boxes is done from platforms on both sides of the service tracks, supported by the sanding towers.

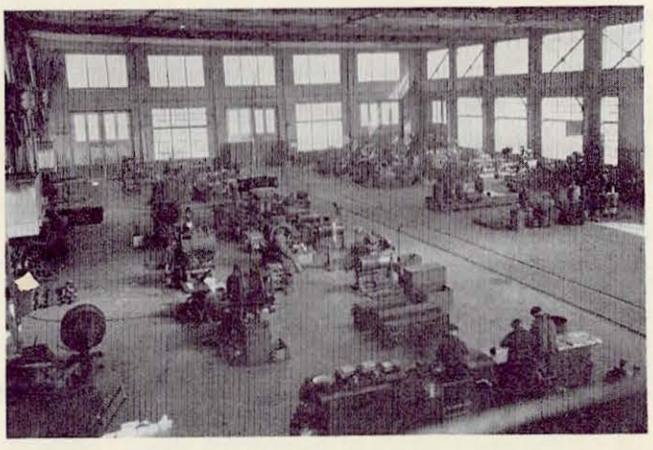
Fuel and Water Supply

The fuel oil supply is kept in underground steel tanks. These tanks are installed at suitable points free of tracks, and the oil is conveyed in underground pipes to the locomotive oiling station. The unloading of tank cars into the supply tanks is by gravity, while the delivery to locomotives is made by oil handling pumps, similar to those employed at filling stations to deliver gasoline to automobiles.

The only unusual features about the water supply facilities are that connection with the water reservoirs of the locomotives is made through flexible hose from ground outlets located at each side of the sanding towers, and that at practically all points the water is treated with a softening compound to minimize its scale forming properties. This latter feature is of particular importance because of the unusually rapid rate of evaporation which takes place in the car heating boilers.

* * *

The field engineering and supervision of the electrification project is handled under the direction of the Electrical Engineer, who, with the aid of an engineering staff, approves and oversees the layout and execution of the field work. The designing engineers are Gibbs and Hill, consulting engineers, New York. The greater part of the construction work is let out to contract, members of the electrical engineer staff serving to supervise and inspect the individual branches of the contract work.

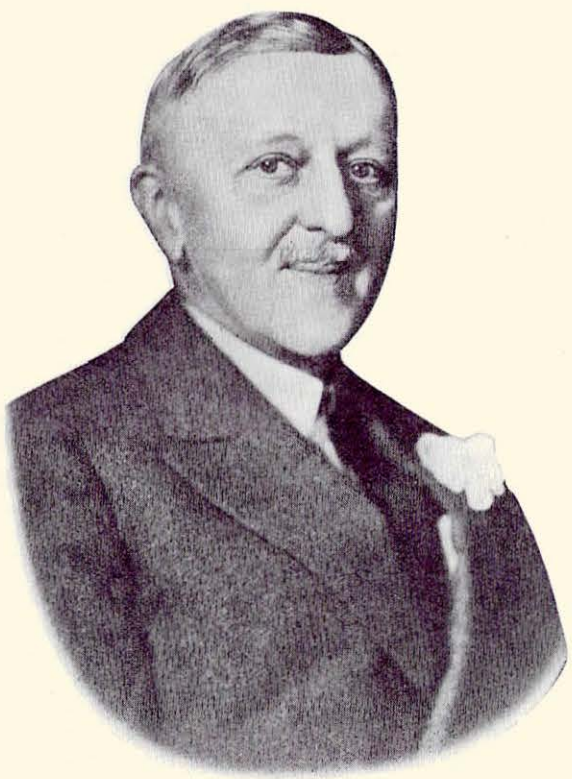


Section of the Multiple-Unit Motor Repair Shop at Wilmington, Del.

William H. Woodin To Become Secretary of Treasury

Selection of well-known railway equipment executive for important cabinet post announced by President-Elect Roosevelt

WILLIAM H. WOODIN, president of the American Car & Foundry Company, and chairman of the board of directors of the American Locomotive Company, has been selected to become secretary of the treasury in the cabinet of President-Elect Franklin D. Roosevelt. Thus, as did his predecessor, President Hoover, so also has Mr. Roosevelt chosen one of his administration leaders from the railway equipment industry. Robert P. Lamont, former president of the American Steel Foundries, served as secretary of commerce from the inception of the Hoover, administration on March 4, 1929, until August, 1932, when he resigned to become president of the American Iron and Steel Institute.



William H. Woodin

The announcement of Mr. Woodin's selection came on February 21 with a statement from the President-Elect which said that Mr. Woodin was "virtually drafted" into the public service since he "was loath to relinquish at this time the active control of the many industrial enterprises with which he has been so long and prominently identified." Mr. Woodin, in a conference with the press on February 23, pointed out that he must necessarily resign his executive positions and directorships in business before assuming office on March 4. This, he said, will be done next week but meanwhile there was no announcement as to his successor or successors in the various executive positions which he holds with equipment companies.

In addition to the positions mentioned at the outset Mr. Woodin is now president of the American Car & Foundry Export Company; president of the American Car & Foundry Securities Corporation; chairman of the board and president of the American Car & Foundry Motors Company; chairman of the board and president of the Brill Corporation; president of the J. G. Brill Company; president and chairman of the board of the American Locomotive Sales Corporation; chairman of the board of the Montreal Locomotive Works, Ltd.; chairman of the board of the Railway Steel-Spring Company; and chairman of the executive committee of the McIntosh & Seymour Corporation. In addition to directorships which he holds in each of the foregoing companies, Mr. Woodin is also a director of the Consolidated Railroad of Cuba, the Superheater Company and the Federal Reserve Bank of New York.

William Hartman Woodin is a descendant of a family which has been associated with railway car building practically since the inception of that industry in this country. In 1849 his grandfather, after whom he is named, entered a partnership with Mordecai W. Jackson to establish at Berwick, Pa., a foundry under the firm name of Jackson & Woodin for the manufacture of stoves, plows, iron pipe and other foundry products. In 1861 this business was extended to include the manufacture of cars and in 1872 it was absorbed by a new company known as the Jackson & Woodin Manufacturing Company. This latter was one of the firms which in 1899 were merged to form American Car & Foundry Company.

Mr. Woodin was born at Berwick, Pa., May 27, 1868, and received a technical education at the Columbia University School of Mines which he attended with the class of 1890. Upon leaving college he entered the shops of the Jackson & Woodin Manufacturing Company at Berwick and in 1892 was appointed general superintendent of that plant. Three years later, in 1895, he was elected vice-president and his promotion to the presidency came in 1899. With the merging of the plant into the American Car & Foundry Company in the latter year, Mr. Woodin was appointed district manager of the Berwick plant. He next became assistant to the first vice-president of the new company and in 1902 he was appointed a director and assistant to the president, having general direction of the company's affairs under President Frederick H. Eaton, whom, on February 1, 1916, Mr. Woodin succeeded in the presidency. Mr. Woodin first became president of the American Locomotive Company in December, 1925, succeeding the late Andrew Fletcher. In May, 1926, however, he temporarily relinquished the position and was succeeded by Frederick F. Fitzpatrick, former president of the Railway Steel-Spring Company. After the death of Mr.

I do not think we depart much from it—to consider quality as the first consideration. That ought to be self-evident, because nobody who has anything to do with railroading dares to depart from quality. If he does, he is liable to get into trouble. Price is a secondary consideration always. Quality being equal, price governs, and traffic considerations come third. And traffic only plays a part when quality and price are the same, as they are on many standard articles.

What About Price Cutting?

We hear a lot about so-called price buying and buying below cost. We buy 99.99 per cent of our goods on the basis of the lowest price obtained on the first bidding from a responsible company. We throw aside low prices from irresponsible companies and for goods that are not proved. When the engineer of tests or any one else puts thumbs down on the quality of an article, it is marked "N.G.", even though the price is low.

I have heard a lot about purchasing agents bringing men in and hammering them down. I know nothing about it. I have heard of purchasing agents holding tabulations of bids on their desks waiting for salesmen to come in and submit prices lower than their own bids. That has never happened to me. If I can debunk a little of that, I will be happy to do so. Nobody can sell below cost very long and stay in business.

Any company must sell below cost commodities that cost them much more than the going price at the time of sale. With copper at five cents a pound, would any purchasing agent be justified in paying 18 cents to avoid buying below cost from a company that had paid 18 cents for the copper? If he persisted, how long would his company stay in business?

A few years ago, a standard commodity was selling at $28 a ton, f. o. b. mill, in the United States. The same commodity was sold at $26 a ton, f. o. b. cars ship side, South Africa. Both of those prices were right. What was the cost of that co[m]modity. Was the commodity that was sold in So[uth] Africa sold below cost? It was not, because the com[pany] that sold it was a hard-headed company that wasn't [selling] anything below cost. Was $28 a ton below cost? It was not.

I have signed a contract [for] the third successive year with a reputable company [for] a regular supply of a commodity of which we use a lot at a price 30 per cent below the standard price submitted by the four principal competitors. Is that company selling below cost? It is not. It is making money. The explanation of the 30-per cent difference in cost is simply this: The higher price included all the out-of-pocket expense for materials, labor, taxes and overhead, plant maintenance, depreciation and profit, and, in addition, a sales expense of about 35 per cent, which included the expense of door-to-door selling not in any way comparable with the quantities we buy or the cost of selling to us. The company that gave us the lower price adds about 5 per cent sales expense, which more than covers their sales expense to us. They are not selling below cost, and I am not buying below cost. Most people who complain about this buying and selling below cost and price cutting are complaining about the fellow who is selling below the price they would like to get. I do not call that buying and selling below cost.

We have an interesting experience with locomotive coal prices. If I should now pay the price we paid in 1928, people would say I was crazy, but if, in 1928, I had suggested that I might buy coal as cheap as we are buying it in 1932, people would also have said I was crazy. Nevertheless, each year we have signed contracts for coal at prices which, we were told, were below cost, only to follow it the next year with contracts at still lower prices. There has been no time in the last five years that I could not have bought coal cheaper than the contract price, and always the company that was selling the coal got something more than its cost. The prices were made by the industry—not us.

Somebody will say: "They are not making money." That brings in the next question: What is cost? At a time of big production and big sales, the total overhead, interest, profit, surplus, taxes and other fixed items go against large volume of business. If you include all this cost at a time when business is running 20 per cent of normal, the charge for these items will be five times as much as in a good year. And you cannot get it in a bad market. Cost must include the out-of-pocket expenses and a reasonable share of the overhead, even if it is not all the overhead.

People will say that is selling below cost, but, if so, it is selling below a cost that nobody can get, so why talk about it?

The effort that is being made to fix prices, to make prices high, is something we do not need to worry about. We can accept it with complacent indifference because, in the long pull, every price-fixing endeavor of history has failed. They have all defeated themselves. And the higher the price is, the quicker it defeats itself and the harder is the fall.

Copper at 5 cents per lb. is the direct result of fixed prices of 18 cents and 24 cents. When copper was fixed at 18 and 24 cents a lb., it encouraged everybody in the world who knew where there was a pound of copper, to get it out. It also encouraged everybody who knew of a substitute that could be used for copper to sell it in competition with copper. The result was a reduction in the demand and an increase in the supply. The law of supply and demand is as inexorable as the rising and setting of the sun. It may be deferred, but it gets in its "licks" in the long run. We are suffering from the working of the law of supply and demand and the way we "monkeyed" with it during the good business years. It would have been better if the prices of some of these commodities had not been fixed so high as to encourage their over-production.

Another interesting doctrine is that before business can recover, prices must return to where they were before they fell. I am afraid we are doomed to disappointment. I received a diagram prepared from figures compiled by Leonard Ayres, of the Cleveland Trust Company, and plotted by the McGill Commodity Service of Auburndale, Mass. It shows that with the average wholesale commodity prices from 1910 to 1914 taken as an average of 100 per cent, there have been only about 10 years in 100 years when those prices have been more than 5 per cent higher, with the exception of two 15-year periods, one during and after the Civil War and the other during and after the World War. For 60 years of that 100-year period, the wholesale commodity prices were just about on the 1910-1914 level, and at times were lower than they are today. The indication of that chart is that we are in for a long period of low wholesale commodity prices, and the sooner we make adjustments to suit, the sooner we will be getting back to a normal volume of business. It also shows that there have been many periods of good business while prices were low.

I have found in the three years I have been buying for the New Haven that a purchasing officer must be above reproach. He must not only be honest, but he must so conduct himself that he will be believed to be honest. There is quite a difference. The former may be taken for granted. The latter must be proved by constant care and watchfulness.

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William H. Woodin

In addition to the positions mentioned at the outset Mr. Woodin is now president of the American Car & Foundry Export Company; president of the American Car & Foundry Securities Corporation; chairman of the board and president of the American Car & Foundry Motors Company; chairman of the board and president of the Brill Corporation; president of the J. G. Brill Company; president and chairman of the board of the American Locomotive Sales Corporation; chairman of the board of the Montreal Locomotive Works, Ltd.; chairman of the board of the Railway Steel-Spring Company; and chairman of the executive committee of the McIntosh & Seymour Corporation. In addition to directorships which he holds in each of the foregoing companies, Mr. Woodin is also a director of the Consolidated Railroad of Cuba, the Superheater Company and the Federal Reserve Bank of New York.

William Hartman Woodin is a descendant of a family which has been associated with railway car building practically since the inception of that industry in this country. In 1849 his grandfather, after whom he is named, entered a partnership with Mordecai W. Jackson to establish at Berwick, Pa., a foundry under the firm name of Jackson & Woodin for the manufacture of stoves, plows, iron pipe and other foundry products. In 1861 this business was extended to include the manufacture of cars and in 1872 it was absorbed by a new company known as the Jackson & Woodin Manufacturing Company. This latter was one of the firms which in 1899 were merged to form American Car & Foundry Company.

Mr. Woodin was born at Berwick, Pa., May 27, 1868, and received a technical education at the Columbia University School of Mines which he attended with the class of 1890. Upon leaving college he entered the shops of the Jackson & Woodin Manufacturing Company at Berwick and in 1892 was appointed general superintendent of that plant. Three years later, in 1895, he was elected vice-president and his promotion to the presidency came in 1899. With the merging of the plant into the American Car & Foundry Company in the latter year, Mr. Woodin was appointed district manager of the Berwick plant. He next became assistant to the first vice-president of the new company and in 1902 he was appointed a director and assistant to the president, having general direction of the company's affairs under President Frederick H. Eaton, whom, on February 1, 1916, Mr. Woodin succeeded in the presidency. Mr. Woodin first became president of the American Locomotive Company in December, 1925, succeeding the late Andrew Fletcher. In May, 1926, however, he temporarily relinquished the position and was succeeded by Frederick F. Fitzpatrick, former president of the Railway Steel-Spring Company. After the death of Mr.

Fitzpatrick in November, 1927, Mr. Woodin was again the American Locomotive Company's president until April, 1929 when, remaining as chairman of the board, he was succeeded in the presidency by William C. Dickerman.

Freight Car Loading

WASHINGTON, D. C.

WITH a large increase in coal traffic, offsetting decreases in other commodities, revenue freight car loading for the week ended February 11, amounted to 501,320 cars. This was an increase of 18,218 cars above the loading for the week before but 60,215 cars less than that for the corresponding week of last year. Coal loading for the week amounted to 146,889 cars, an increase of 40,672 cars as compared with the week before and of 35,973 cars as compared with last year. Loading of coke and ore also showed increases as compared with the preceding week but other commodity classifications showed decreases, including a reduction of 10,752 cars in miscellaneous freight. The summary, as compiled by the Car Service Division of the American Railway Association, follows:

Revenue Freight Car Loading

Week Ended Saturday, February 11, 1933

Districts	1933	1932	1931
Eastern	119,456	126,813	164,357
Allegheny	93,627	112,118	147,522
Pocahontas	40,885	623	43,658
Southern	307	706	112,268
Northwestern	[illegible]	84,482	87,964
Central Western	[illegible]	85,195	105,936
Southwestern	43,211	48,598	58,984
Total Western Districts	165,045	198,275	252,884
Total All Roads		561,535	720,689
Commodities			
Grain and Grain Products	21,461	32,023	41,279
Live Stock	15,729	18,754	23,033
Coal	146,889	110,916	148,209
Coke	7,297	5,676	9,192
Forest Products	12,243	19,747	34,883
Ore	2,095	2,853	5,899
Mdse. L. C. L.	154,052	186,569	212,610
Miscellaneous	141,554	184,997	245,584
February 11	501,320	561,535	720,689
February 4	483,192	573,923	719,053
January 28	472,088	560,343	719,397
January 21	496,434	562,101	715,474
January 14	506,322	572,649	725,212
Cumulative totals, 6 weeks	2,895,008	3,402,229	4,312,953

Car Loading in Canada

Car loadings in Canada for the week ended February 11 amounted to 30,691 cars, as compared with 31,911 cars for the previous week and 31,437 cars for the fourth week. The very low temperature which was more or less general over all of Canada for most of the week was undoubtedly the main reason for the decrease instead of the usual increase. The index number dropped from 55.93 for the previous week to 53.22 which is a new low record for the past two years.

	Total Cars Loaded	Total Cars Rec'd from Connections
Total for Canada:		
February 11, 1933	30,691	16,211
February 4, 1933	31,911	17,119
January 28, 1933	31,437	17,474
February 13, 1932	41,234	22,214
Cumulative Totals for Canada:		
February 11, 1933	186,397	100,853
February 13, 1932	242,061	122,910
February 7, 1931	269,138	159,300

Transportation Leadership Needed

THERE is a crying need for leadership in the transportation field today, but "railroad managements" are running in circles, according to E. A. Jack, general traffic manager of the Aluminum Company of America, in an address before the Traffic Club of Chicago on February 16. He spoke in part as follows:

"Everyone knows that the motor truck is not as economically efficient as the railroad, but it is thriving on the rates the railroads have been forced to charge because of the tape worms we have foisted on them through silly legislation. But so completely are we hypnotized by the professional politician that the only remedy we can think of is to pass more 'damfool' laws.

"In just the degree that one lets himself be dominated by another, in just that degree does the one dominated lose the capacity to think. Bureaucracy is the champion think deleter and leadership exterminator. Think of the crying need for leadership in the transportation field today and the pitiful absence of it. Railroad managements are running in circles, and this is particularly true among traffic men. Some traffic men, recognizing the fact that it is the bureaucracy-made rates that are at the root of the truck competition, are trying to meet that situation in a logical way by making the railroad rates and service conform to the rates and service of their competitors, while at the same time another group of traffic men, known as the Commodity Rate Revision committee, are wasting their time and that of others in the perfectly absurb attempt to relate commodity rates to the purely empirical first-class rate, losing sight entirely of the fact that it is just such technocratic rate making that has produced the truck competition and which the other branch of the traffic department is going gray-headed trying to meet.

Subsidizing the Truck

"Now, while one traffic committee is losing itself in the maze of commodity rate technocracy and another lot of traffic officials are doing their best to repair the damage done by such rate technocracy, a third branch of the railroad is flooding the country with malicious, though clever and adroit, propaganda based on half knowledge at best and frequently on nothing more than prejudice, in an effort to force upon truck and barge lines the same kind of technocratic regulation which has brought the railroads to their present plight. Spurred by such adroit propaganda which we swallow without reasoning, we raise a great hue and cry about subsidizing the trucks, providing free rights of way for them, etc., while in the same breath we go into ecstasies over the announcement that the government is going to expend millions to develop the inland waterways, notwithstanding the fact that it has been proven that every dollar spent in an effort to create and maintain artificial channels in our rivers has been worse than wasted.

"There is fundamentally but one justification for the establishment of an additional transportation facility and that is: Will it increase the volume of commerce? If such additional facility will not increase the volume of commerce, then, regardless of whether it performs the service at lesser cost or in a better way, it is of highly doubtful economic value. Nevertheless, we continue to follow will-o'-the-wisps put forward by persuasive oratory or appeals to prejudice and ignorance, instead of exercising our gray matter and reaching conclusions based on sound judgment. Then we wonder why we have not any sound constructive leadership."

"Some Observations on Railway Purchasing"*

Ethics, buying below cost and price-fixing discussed in talk before New England Railroad Club

By C. E. Smith

Vice-President, Purchases and Stores, New York, New Haven & Hartford

I OCCUPY a rather unique position because after 30 years' service as an engineer, I was suddenly thrust into purchasing three years ago and had to start at the bottom and work my way up. I have discovered that there is a considerable difference between being an engineer and a purchasing agent. The Railway Business Association printed a bulletin in November, 1930, entitled "Principles and Standards of Purchasing Practice," which began as follows:

"Darwin seems not to have studied railroad purchasing agents or supply men, but his observations of animals suggest the phenomena he would have reported if he had labored in that interesting field.

"A purchasing agent is a hedonist if it gives him ghoulish glee to chop the price. His favorite character in fiction is the Emperor of Japan in Gilbert and Sullivan's Operetta, The Mikado, a potentate deriving his highest ecstasy from the agonies of the unfortunates who come to do business with him and whom he exultingly boiled in oil."

Elbert Hubbard also wrote a definition of a purchasing agent. He said:

"The typical buyer is a man past middle life, spare, wrinkled, intelligent, cold, passive, non-committal; with eyes like a codfish, polite in contact, but at the same time unresponsive, cool, calm and as damnably composed as a concrete post or a plaster-of-Paris cast; a human petrification with a heart of feldspar and without charm or the friendly germ, minus bowels, passions, or a sense of humor. Happily they never reproduced, and all of them finally go to hell."

The reason for such statements is that no matter how conservative and fair a purchasing agent may try to be, everytime he takes bids from more than one bidder, he can only make one happy; if there are ten on the list, he makes nine unhappy, and as time goes on, there is a much larger number of disappointed bidders than happy bidders.

The National Association of Purchasing Agents is composed of about 3,000 purchasing officers of our largest industries. It is a very live and active organization, and its code of ethics and standards of buying and selling should please any seller or any manufacturer. They are:

(1) To consider, first, the interests of his company in all transactions and to carry out and believe in its established policies.

(2) To be receptive to competent counsel from his colleagues and to be guided by such counsel without impairing the dignity and responsibility of his office.

(3) To buy without prejudice, seeking to obtain the maximum ultimate value for each dollar of expenditure.

(4) To strive consistently for knowledge of the materials and processes of manufacture, and to establish practical methods for the conduct of his office.

(5) To subscribe to and work for honesty and truth in buying and selling, and to denounce all forms and manifestations of commercial bribery.

(6) To accord a prompt and courteous reception, so far as conditions will permit, to all who call on a legitimate business mission.

(7) To respect his obligations and to require that obligations to him and to his concern be respected, consistent with good business practice.

(8) To avoid sharp practice.

(9) To counsel and assist fellow purchasing agents in the performance of their duties, whenever occasion permits.

(10) To co-operate with all organizations and individuals engaged in activities designed to enhance the development and standing of purchasing."

On the whole, purchasing pretty fairly conforms with the principles laid down.

Purchasing Details Many

Few know how much detail work there is in a purchasing department. On the New Haven, a count was made one month of all the various operations going through the office. From that we determined that we were receiving and sending 1,000 letters a day, 300,000 letters a year, receiving 35,000 requisitions, sending out 3,500 inquiries for bids to 35,000 firms, and placing 80,000 orders for 200,000 items. We were receiving and checking over 100,000 invoices and rendering over 40,000 vouchers. In our material stores at various points we have in stock over 50,000 separate items. A short time ago I had placed in front of me a tabulation of bids on gaskets for an automotive unit. There were 812 separate gaskets on that list.

With all that detail, one can see the reason for the pained look that comes over a purchasing agent's face when a technician on any particular thing starts to give a technological lecture on that particular commodity. The purchasing agent must be as much interested in 49,999 other things. He is interested in getting proper quality and in having the right amount in stock, but not too much.

Railroad buying is a little different from other buying. Every salesman is a potential customer of the railroad. He is either a potential traveler or his company is a potential or actual shipper. Where the purchasing agent of any other industry can see people or not see them, as he pleases, the purchasing agent of a railroad cannot afford to do that, because if he refuses two or three times, the salesman's superior will be calling on his superior and he will be asked what he is doing to run business away from his railroad.

The question of reciprocity comes in. I call it traffic diplomacy. Many express the idea that reciprocity cannot be practiced without sacrificing quality and paying more for goods. That is not necessarily so, and I believe is quite exceptional. It is just as easy to buy from people who are reasonable, on a reciprocity basis and secure proper quality and the best prices, as it is to buy on any other basis. We try in our buying—and

*From an address entitled "Some Phases of the Present Railroad Situation", presented in Boston, Mass., on December 13, 1932.

I do not think we depart much from it—to consider quality as the first consideration. That ought to be self-evident, because nobody who has anything to do with railroading dares to depart from quality. If he does, he is liable to get into trouble. Price is a secondary consideration always. Quality being equal, price governs, and traffic considerations come third. And traffic only plays a part when quality and price are the same, as they are on many standard articles.

What About Price Cutting?

We hear a lot about so-called price buying and buying below cost. We buy 99.99 per cent of our goods on the basis of the lowest price obtained on the first bidding from a responsible company. We throw aside low prices from irresponsible companies and for goods that are not proved. When the engineer of tests or any one else puts thumbs down on the quality of an article, it is marked "N.G.", even though the price is low.

I have heard a lot about purchasing agents bringing men in and hammering them down. I know nothing about it. I have heard of purchasing agents holding tabulations of bids on their desks waiting for salesmen to come in and submit prices lower than their own bids. That has never happened to me. If I can debunk a little of that, I will be happy to do so. Nobody can sell below cost very long and stay in business.

Any company must sell below cost commodities that cost them much more than the going price at the time of sale. With copper at five cents a pound, would any purchasing agent be justified in paying 18 cents to avoid buying below cost from a company that had paid 18 cents for the copper? If he persisted, how long would his company stay in business?

A few years ago, a standard commodity was selling at $28 a ton, f. o. b. mill, in the United States. The same commodity was sold at $26 a ton, f. o. b. cars ship side, South Africa. Both of those prices were right. What was the cost of that commodity. Was the commodity that was sold in South Africa sold below cost? It was not, because the company that sold it was a hard-headed company that wasn't selling anything below cost. Was $28 a ton below cost? It was not.

I have signed a contract for the third successive year with a reputable company for a regular supply of a commodity of which we use a lot at a price 30 per cent below the standard price submitted by the four principal competitors. Is that company selling below cost? It is not. It is making money. The explanation of the 30-per cent difference in cost is simply this: The higher price included all the out-of-pocket expense for materials, labor, taxes and overhead, plant maintenance, depreciation and profit, and, in addition, a sales expense of about 35 per cent, which included the expense of door-to-door selling not in any way comparable with the quantities we buy or the cost of selling to us. The company that gave us the lower price adds about 5 per cent sales expense, which more than covers their sales expense to us. They are not selling below cost, and I am not buying below cost. Most people who complain about this buying and selling below cost and price cutting are complaining about the fellow who is selling below the price they would like to get. I do not call that buying and selling below cost.

We have an interesting experience with locomotive coal prices. If I should now pay the price we paid in 1928, people would say I was crazy, but if, in 1928, I had suggested that I might buy coal as cheap as we are buying it in 1932, people would also have said I was crazy. Nevertheless, each year we have signed contracts for coal at prices which, we were told, were below cost, only to follow it the next year with contracts at still lower prices. There has been no time in the last five years that I could not have bought coal cheaper than the contract price, and always the company that was selling the coal got something more than its cost. The prices were made by the industry—not us.

Somebody will say: "They are not making money." That brings in the next question: What is cost? At a time of big production and big sales, the total overhead, interest, profit, surplus, taxes and other fixed items go against large volume of business. If you include all this cost at a time when business is running 20 per cent of normal, the charge for these items will be five times as much as in a good year. And you cannot get it in a bad market. Cost must include the out-of-pocket expenses and a reasonable share of the overhead, even if it is not all the overhead.

People will say that is selling below cost, but, if so, it is selling below a cost that nobody can get, so why talk about it?

The effort that is being made to fix prices, to make prices high, is something we do not need to worry about. We can accept it with complacent indifference because, in the long pull, every price-fixing endeavor of history has failed. They have all defeated themselves. And the higher the price is, the quicker it defeats itself and the harder is the fall.

Copper at 5 cents per lb. is the direct result of fixed prices of 18 cents and 24 cents. When copper was fixed at 18 and 24 cents a lb., it encouraged everybody in the world who knew where there was a pound of copper, to get it out. It also encouraged everybody who knew of a substitute that could be used for copper to sell it in competition with copper. The result was a reduction in the demand and an increase in the supply. The law of supply and demand is as inexorable as the rising and setting of the sun. It may be deferred, but it gets in its "licks" in the long run. We are suffering from the working of the law of supply and demand and the way we "monkeyed" with it during the good business years. It would have been better if the prices of some of these commodities had not been fixed so high as to encourage their over-production.

Another interesting doctrine is that before business can recover, prices must return to where they were before they fell. I am afraid we are doomed to disappointment. I received a diagram prepared from figures compiled by Leonard Ayres, of the Cleveland Trust Company, and plotted by the McGill Commodity Service of Auburndale, Mass. It shows that with the average wholesale commodity prices from 1910 to 1914 taken as an average of 100 per cent, there have been only about 10 years in 100 years when those prices have been more than 5 per cent higher, with the exception of two 15-year periods, one during and after the Civil War and the other during and after the World War. For 60 years of that 100-year period, the wholesale commodity prices were just about on the 1910-1914 level, and at times were lower than they are today. The indication of that chart is that we are in for a long period of low wholesale commodity prices, and the sooner we make adjustments to suit, the sooner we will be getting back to a normal volume of business. It also shows that there have been many periods of good business while prices were low.

I have found in the three years I have been buying for the New Haven that a purchasing officer must be above reproach. He must not only be honest, but he must so conduct himself that he will be believed to be honest. There is quite a difference. The former may be taken for granted. The latter must be proved by constant care and watchfulness.

Motor Transport Section

Pacific Greyhound Gains in Depression

Net profit for 1932 was $412,960, compared to $382,964 in 1931—Expenses rigidly curtailed

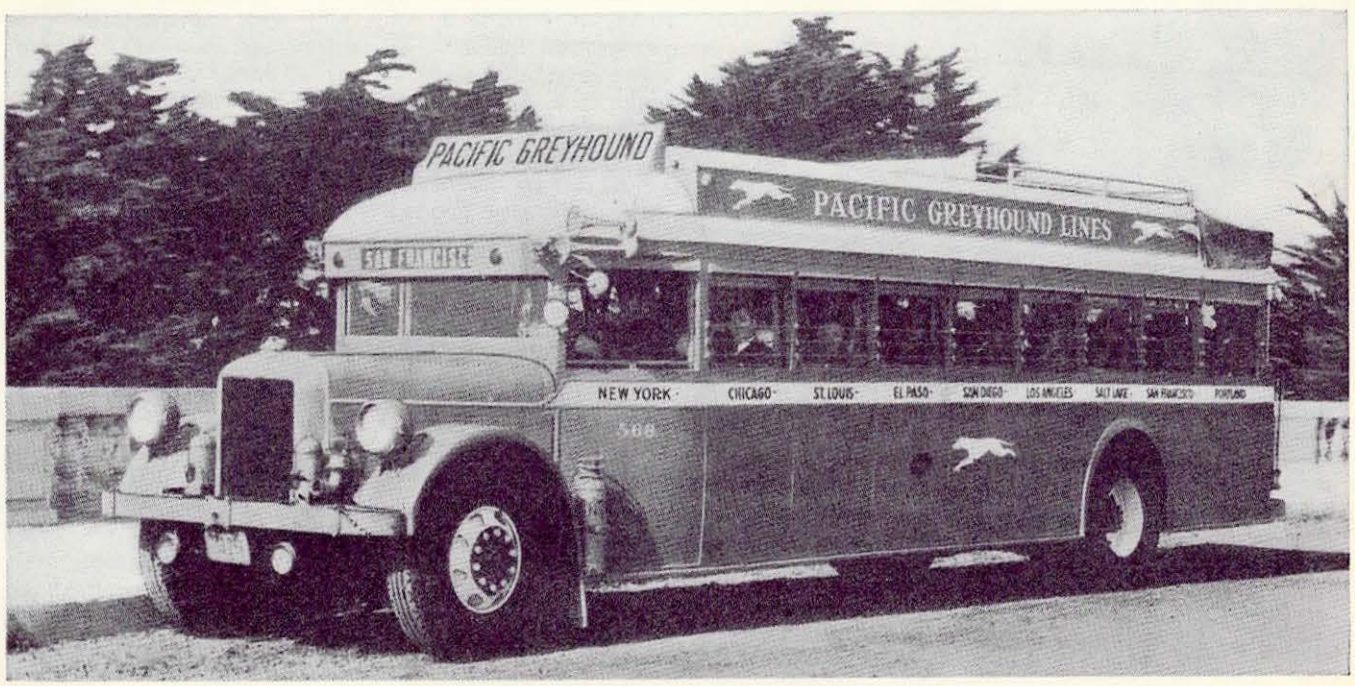
IN 1932, as in previous years, the Pacific Greyhound Corporation, motor coach operating affiliate of the Southern Pacific and the Great Northern, continued to forge ahead in spite of depressed business conditions. When most other industries and transportation companies were reporting substantial deficits, and while the number of receiverships steadily mounted, the Pacific Greyhound Corporation had a net income in 1932 of more than $400,000, an increase of $30,000 over that of 1931.

The Pacific Greyhound Corporation is the holding company for the Pacific Greyhound Lines. The Southern Pacific holds one-third of the capital stock of the holding company, while the Great Northern is also a stockholder of substantial size. The record which the company made in 1932, under the leadership of T. B. Wilson, president of the Pacific Greyhound Corporation, and formerly in charge of the Southern Pacific Motor Transport Company, original bus operating subsidiary of the railway, has attracted wide attention on the Pacific Coast and among transportation men throughout the United States.

The increase in net income in spite of reduced revenues in 1932 was accomplished by the application of strict economy to every phase of the company's activities. Each item in the company's operations was carefully scrutinized from the standpoint of savings which might be made in connection with it, to the extent permitted by maintenance of unimpaired transportation service.

How Expenses Were Reduced

Expenses were reduced in many ways under the regime of economy instituted by the management. First, there was a lopping off of a number of unproductive routes, resulting in a reduction in the number of miles of routes operated to 7,891, as compared to 8,445 in 1931. Second, there were numerous consolidations of motor coach schedules where these could be carried out without materially injuring the service offered to the public. As a result, the total bus-miles operated in 1932 were 19,812,838, compared with 23,919,880 in the previous year. Operating and maintenance methods were so revised as to eliminate every element of cost beyond those strictly necessary, with results which were reflected in a large number of the operating statistics for the year. Equipment and practices were standardized. A strong and successful drive was made to reduce accidents, with the result that repair and insurance costs were substantially reduced. One of the factors contributing to the reduction of accidents was the establishment of a bonus system, whereby motor coach drivers were given bonuses in addition to their wages, these



One of the Pacific Greyhound Lines' 381 Modern Motor Coaches

bonuses amounting to one-half cent per mile operated without accidents after six months without an accident. The drive for economy in operation was matched by the drive for traffic, with the result that revenues, while lower than those in 1931, did not represent as severe a decline as noted on many other transportation companies.

Expense Reduction Greater Than Revenue Loss

The consolidated profit and loss statement of the Pacific Greyhound Corporation and its subsidiaries for the years 1932 and 1931 is shown in the accompanying tabulation. Operating revenues declined from $6,569,727 in 1931 to $4,960,807 in 1932, a reduction in revenue per bus-mile operated from 27 cents to 25 cents. On the other hand, total operating expenses were reduced from $6,208,826 in 1931 to $4,519,060 in 1932, a reduction in operating expenses per bus-mile from 26 cents to 23 cents. In other words, while operating revenues were declining two cents per motor coach-mile, operating expenses were being reduced three cents per motor coach-mile.

Net operating income for 1932 was $441,746, as compared with $360,901 in 1931. This represented a net operating income of two cents per motor coach-mile in 1932, as compared to 1.5 cents per motor coach-mile in 1931. The addition of other income and the subtraction of various deductions brought the net income after interest and other charges to $412,960 in 1932, or two cents per motor coach-mile. In 1931, the net income was $382,964, or 1.6 cents per motor coach-mile.

All items of operating revenue except "other transportation revenue" and revenue from the rental of equipment were smaller in 1932 than in the previous year. Passenger revenue declined from $6,197,120 to $4,682,009. Charter revenue declined from $63,038 to $45,602, express revenue from $220,793 to $159,395, newspaper revenue from $66,589 to $52,654, and mail revenue from $87,905 to $60,754. Other transportation revenue in 1932 was $22,360, as compared to $1,043 in 1931. Revenue from the rental of equipment was $8,124 in 1932, compared to $1,012 in 1931.

The largest savings in operating expenses, aside from a reduction in the charges for depreciation and retirement, were made in connection with transportation expenses and maintenance and garage expenses. There were substantial reductions in all but 5 of the 31 items under the maintenance and garage expense account. Part of these were due to the reduction in motor coach-miles operated, but in all but 10 of the items, there were reductions in maintenance and garage expenses on the basis of expense per motor coach-mile operated. Motor coach repairs of all kinds cost $456,492 in 1932, as compared to $596,740 in 1931. Tires cost $169,986 in 1932, as compared to $228,098 in 1931. Total maintenance and garage expenses, excluding provision for obsolete material and inventory shortages, were $871,147 in 1932, or 4.4 cents per motor coach-mile. In 1931, these expenses aggregated $1,217,940, or 5.1 cents per motor coach-mile.

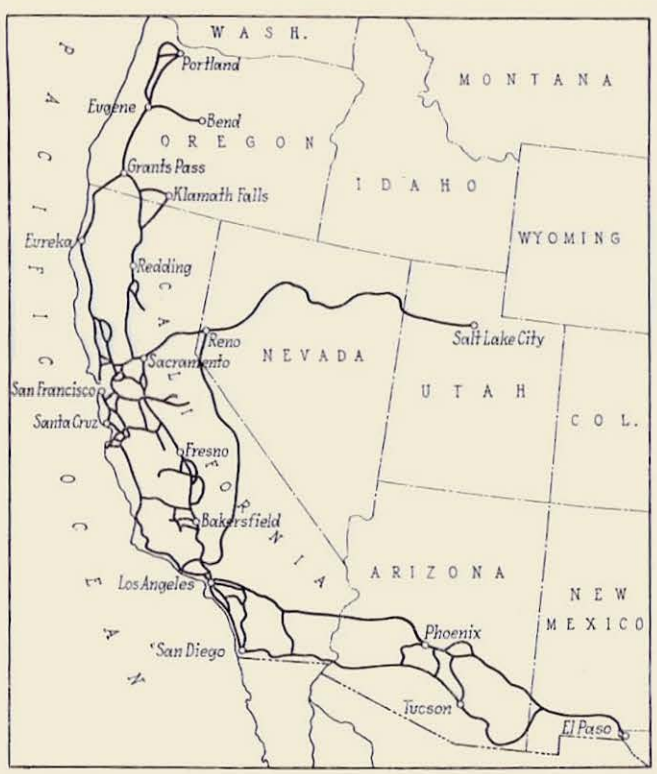
Transportation expenses declined from $1,504,696 in 1931 to $1,176,370 in 1932. Transportation expenses per motor coach-mile in 1932 were 5.9 cents, as compared to 6.3 cents in 1931. There was a substantial reduction of expenses for supervision of transportation. Drivers' wages were reduced from $846,271 in 1931 to $548,650 in 1932, although this was partly offset by the increase in bonuses to drivers, these having increased from $17,930 in 1931 to $83,137 in 1932. This increase

(Continued on page 311)

Pacific Greyhound Operating Results in 1932

	1932 Amount	1932 Per Mile	1931 Amount	1931 Per Mile	Inc. Per Mile*
Operation Revenues	$4,960,807.25	$0.25038	$6,569,727.17	$0.27465	*$0.02427*
Operating Expenses					
Maintenance and Garage Expenses	898,999.93	0.04537	1,238,509.97	0.05178	*0.00641*
Transportation Expenses	1,176,370.93	0.05938	1,504,696.03	0.06290	*0.00352*
Station Expenses	494,419.63	0.02495	617,416.29	0.02581	*0.00086*
Traffic Promotion Expenses	150,463.92	0.00760	196,494.49	0.00822	*0.00062*
Advertising Expenses	135,208.07	0.00682	203,340.36	0.00850	*0.00168*
Insurance and Safety Expenses	200,435.43	0.01012	252,370.26	0.01055	*0.00043*
Administrative Expenses	345,390.23	0.01743	493,275.50	0.02062	*0.00319*
Operating Taxes	477,457.56	0.02410	572,202.22	0.02392	0.00018
Depreciation and Retirements	640,315.21	0.03232	1,130,521.01	0.04726	*0.01494*
Total Operating Expenses	$4,519,060.91	$0.22809	$6,208,826.13	$0.25956	*$0.03147*
Net Operating Profit or *Loss*	441,746.34	0.02229	360,901.04	0.01509	0.00720
Other Income	126,803.59	0.00640	234,415.92	0.00980	*0.00340*
	568,549.93	0.02869	595,316.96	0.02489	0.00380
Other Deductions	155,589.62	0.00785	212,352.79	0.00888	*0.00103*
Net Profit or *Loss*	$412,960.31	$0.02084	$382,964.17	$0.01601	$0.00483

* Decreases shown in italics.



The Principal Motor Coach Routes of the Pacific Greyhound Lines

State Motor Vehicle Legislation

Up-to-date compilation issued by A.R.A. Committee on Relations of Railway Operation to Legislation

Part II

THE A.R.A. Committee on Relations of Railway Operation to Legislation, as pointed out in the *Railway Age* of January 28 when the first part of this article was published, has issued a compilation of present state laws covering the regulation and taxation of highway motor carriers. The January 28 article summarized the laws of the first 15 states taken alphabetically—Alabama to Kentucky inclusive. From that point the compilation is continued herewith:

Louisiana

State Agency Exercising Control: Public Service Commission fixes fares, rates, etc., but has no authority over contract carriers.

Prerequisites of Operation: Certificate of public convenience and necessity, for common carriers of passengers or freight. Bond or insurance policy to be furnished for passenger and freight in amounts to be fixed by Commission as follows: Buses less than 7 passengers, $5,000; more than 7 passengers, $30,000; more than 30 passengers, upward of $30,000, in discretion of commission; $10,000, property damage insurance. Motor trucks $10,000 policy covering personal injury or property damage.

Dimensions: Length, single unit, 33 ft., combination, 55 ft. (after January 1, 1934, 45 ft.); width, 8 ft.; height, 12½ ft.; number of vehicles in any train or combination is limited to two after January 1, 1934. Weight: Net load, single vehicle, 7,000 lb.; truck-tractor, semi-trailer combined, 10,000 lb.; tire loads are limited to 600 lb. per in. width of tire. Exceptions: When used to transport property between points of origin or destination and common carrier loading points, or when transporting commodities to a mill, factory, gin or refinery for the inception of manufacture, the length of haul in both cases being limited to 30 miles, the maximum net load permitted on any vehicle or combination of vehicles is 14,000 lbs. When used by the owners of the vehicle in transporting property manufactured by or belonging to such owner, where the net load thereof, at the beginning of the trip, does not exceed 12,000 lbs. and at the end of the trip is substantially nothing and the total distance of such trip does not exceed 60 miles.

Taxes: Buses (license fee), 7 passengers or less, $2.25 per passenger; 8 to 12 passengers, $3 per passenger; 13 to 21 passengers, $4.50 per passenger; 22 to 29 passengers, $6 per passenger; 30 to 48 passengers, $7.50 per passenger; over 48 passengers, $11.25 per passenger; also $1.02 per h.p.

Truck License Fees

Private Trucks

Net carrying capacity (pounds)	Solid tires	Pneumatic tires	Rate per h.p. (cents)
3,000 or less	$9	$5	68
3,001 to 4,000	11	10	68
4,001 to 5,000	11	10	68
5,001 to 6,000	14	13	68
6,001 to 7,000	20	18	68
7,001 to 8,000	28	26	68
8,001 to 10,000	37	32	68
10,001 to 12,000	*	*	68
12,001 to 14,000	*	*	68

* Above 10,000 lb. add $150 per 1,000 lb. or fraction.

Common and Contract Carrier Trucks

Net carrying capacity (pounds)	Solid tires	Pneumatic tires	Rate per h.p.
3,000 or less	$12.75	$9.00	$1.02
3,001 to 4,000	12.75	9.00	1.02
4,001 to 5,000	28.50	22.50	1.02
5,001 to 6,000	39.00	33.00	1.02
6,001 to 7,000	43.50	39.00	1.02
7,001 to 8,000	43.50	39.00	1.02
8,001 to 10,000	49.50	43.50	1.02
10,001 to 12,000	66.00	61.50	1.02
12,001 to 14,000	78.00	75.00	1.02

Trailer license fees: All trailers and semi-trailers pay registration license fees amounting to two-thirds of the weight tax only, shown above for trucks of their respective classifications. Truck-tractor license fees: Truck-tractors pay the horsepower fee only, shown for their respective classes above.

Partial refund intra-state motor carriers: The amount of the privilege taxes which have been included in all of the foregoing schedules of fees prescribed for intra-state common and contract or charter carriers of both freight and passengers under Act 20 of 1932, Section 26, Par. (d), being 50 per cent of and additional to the respective basic schedules prescribed, are subject to partial refund in such cases where the total annual mileage traversed by the vehicle so licensed is 30,000 miles or less, the amount of such refund being as follows: Up to and including 5,000 miles, 75 per cent; 5,001 to 10,000 miles, 50 per cent; 10,001 to 20,000 miles, 33⅓ per cent; 20,001 to 30,000 miles, 25 per cent; over 30,000 miles, none. Partial refund interstate motor carriers: The refund of the privilege tax to common and contract or charter carriers doing an interstate business is based upon that proportionate part thereof which the vehicle mileage outside of the State of Louisiana bears to the total vehicle mileage within and without the State; plus an additional proportionate part of such remaining amount as is provided by the scale of refunds shown in the immediately preceding paragraph. Section 26, Par. (e). Claims for all refunds must be made within one year after the expiration of the period for which the tax is paid. Sec. 26, Par. (e), Act 20, 1932.

Maine

State Agency Exercising Control: Public Utilities Commission's jurisdiction extends to every person, firm or corporation operating any motor vehicle upon any public street or highway for the carrying of passengers for hire, provided the same are operated over regular routes between points in the state; commission may make rules and regulations covering the operation of such motor vehicles including provisions concerning route, schedules, rates and fares and such other reasonable regulations as may be deemed necessary for the safety or convenience of the public; no jurisdiction over operation of motor trucks.

Prerequisites of Operation: Certificate from commission permitting such operation; insurance or bond covering claims for personal injury or property damage to be furnished in such amount as the commission may determine; covers passenger carriers only.

Dimensions: Width, 96 in.; height, 12½ ft.; weight, axle, 13,500 lb., gross, 18,500 lb., for single vehicle; 50 per cent greater for 2 vehicles combined.

Taxes: Buses—Registration fees of 50 cents per h.p. and 50 cents per 100 lb. weight; motor vehicles of over 7 persons seating capacity, $2.50 for each seat over 7 in addition. Trucks—Registration fees graduated from $10 for trucks carrying 1,000 lb. or less to $150 for trucks carrying more than 5 tons; no other taxes except those payable to municipalities based upon property value.

Maryland

State Agency Exercising Control: Public Service Commission has jurisdiction, upon application for permit, to investigate number of vehicles to be used, and the rate to be charged.

Prerequisites of Operation: Permit from Public Service Commission, to operate over roads and streets.

Dimensions: Width, 7¾ ft., tractors, 8⅓ ft. Weight (including load), 4 wheel vehicles, 25,000 lb.; 6 wheel vehicles, 40,000 lb. The figures given for dimensions, weight and carrying capacity are applicable to motor vehicles in general; there are no special regulations on these subjects in the Motor Bus Law.

Taxes: Passenger, 1/18 cent per mile; freight, 1/5 cent per ton-mile.

Massachusetts

State Agency Exercising Control: Department of Public Utilities fixes rates, fares, etc.; no regulation covering the transportation of freight.

Prerequisites of Operation: Certificate of public convenience and necessity; bond or other security in amount to be fixed by the Department.

Dimensions: Length, vehicle and semi-trailer, 40 ft., any other motor vehicle or trailer, 33 ft.; width, 8½ ft. Weight, vehicle without pneumatic tires, 28,000 lb.; with pneumatic tires, 30,000 lb.; semi-trailer unit, 40,000 lb.

Taxes: Gasoline vehicles—7 passengers or less, $1.25 per seat, over 7 passengers, $1.50 per seat, minimum fee, $6; non-gasoline vehicles—7 passengers or less, $4 per seat, over 7 passengers, $5 per seat, minimum fee, $20. There is a state tax which is equivalent to a capital stock tax; in addition, there is a local tax known as the Motor Excise Tax levied by the cities and towns in which the motor coach is garaged. This latter is based upon the value of the equipment and is identical to a similar tax assessed on private automobiles.

Michigan

State Agency Exercising Control: Public Utilities Commission fixes maximum rates, fares, etc., of public carriers; also has jurisdiction over private carriers for hire—to provide for safety of operation, issuance of permits, filing of reports, etc.

Prerequisites of Operation: Public Carriers—certificate of public convenience and necessity on ten days notice "to all other common and public carriers operating in the same territory," good for one year; private carriers for hire—yearly permits conditioned on observance of regulations and payment of taxes. Indemnity Bond or Insurance in amounts to be fixed by Commission.

Dimensions: Length, single unit, 40 ft., combination (2 trailers maximum), 60 ft.; width, 8 ft. overall; height, 14 ft. Weight (graduated system depending on axle width, season and road): For 9 ft. axle, limit is normally 18,000 lb.—in spring months on concrete and other roads respectively, 13,500 lb. and 10,000 lb.; for 6 ft. axle, limit is normally 11,500 lb. with 8,600 and 6,400 lb. in spring months on concrete and other roads respectively; also, maximum of 525 and 450 lb. per in. of tire width on concrete and other roads respectively in spring months; requirements as to spring months are subject to local or general suspension in discretion of highway commissioner.

Taxes: In addition to registration and license fees $1 per year for 100 lb. gross weight of vehicle fully equipped.

Minnesota

State Agency Exercising Control: Railroad and Warehouse Commission fixes rates, fares, etc., of common carriers—passenger or freight.

Prerequisites of Operation: Certificate of public convenience and necessity; liability on property damage; insurance policy or surety bond in amount fixed by Commission; common carriers—passenger or freight.

Dimensions: Length, single unit, 35 ft., combination, 75 ft.; width,

8 ft. On November 30, 1933, the over-all length limit was reduced to 60 ft. with a 5 per cent overrun on said length. Weight (gross): Vehicles driven on highways—4 wheels, 28,000 lb., 1 axle, 22,400 lb.; combination of vehicles, 28,000 lb.; if equipped with pneumatic tires and axles 8 ft. or more apart—wheel weight, 9,000 lb., axle weight, 18,000 lb.; if equipped with pneumatic tires and axles less than 8 ft. apart—wheel weight, 6,000 lb., axle weight, 12,000. Vehicles driven on industrial roads—if equipped with pneumatic tires and axles 8 ft. or more apart—wheel weight, 11,200 lb., axle weight, 22,400; if equipped with pneumatic tires and axles less than 8 ft. apart—wheel weight, 8,000 lb., axle weight, 16,000 lb. Vehicles equipped with solid tires 80 per cent of above weights.

Taxes: Based on license plate fees; for common carrier trucks and buses the license plate fee is computed on 10 per cent of vehicle's purchase price, decreased each year vehicle is kept in operation.

Mississippi

State Agency Exercising Control: Railroad Commission fixes rates, fares, etc., of common carriers, passenger or freight.

Prerequisites of Operation: Certificate of public convenience and necessity for common carriers; bond and insurance policy to be furnished; bond of $500 payable to the State and public liability bond in amount fixed by Commission, but not less than $5,000.

Dimensions: Length, single unit, 33 ft., combination, 50 ft.; width, 8 ft.; height, 12½ ft. Weight: Single unit, net load, 14,000 lb., vehicle and load, 22,000 lb.; combination, vehicle and load, 30,000 lb.

Taxes: Buses and automobiles—15 cents per h.p. plus 50 cents per 100 lb. gross weight; buses, in addition—7 passengers or less, $30 plus ¼ cent per mi., 8 to 13 passengers, $60 plus ½ cent per mi., 14 to 19 passengers, $90 plus ¾ cent per mi., 20 to 25 passengers, $120 plus 1 cent per mi., 26 and more passengers, $180 plus 1½ cents per mi. Trucks (including private trucks)—½ ton capacity or less, $15 plus .1 cent per mi., over ½ ton not over 1 ton, $22.50 plus .2 cent per mi., 1 ton to 1½ ton, $35 plus .3 cent per mi., 1½ ton to 1¾ ton, $50 plus .4 cent per mi., 1¾ ton to 2 ton, $60 plus .5 cent per mi., 2 ton to 2¼ ton, $72 plus .6 cent per mi., (these rates are reduced 10 per cent each year of registration up to total of 50 per cent); 2½ ton, $84 plus .7 cent per mi., 2½ ton to 3 ton, $108 plus .9 cent per mi., 3 ton to 3½ ton, $132 plus 1.1 cents per mi., 3½ ton to 4 ton, $156 plus 1.3 cents per mi., 4 ton to 4½ ton, $192 plus 1.6 cents per mi., 4½ ton to 5 ton, $240 plus 2 cents per mi., 5 ton to 6 ton, $300 plus 2.5 cents per mi., 6 ton to 7 ton, $360 plus 3 cents per mi. (Tractor and semi-trailer units charged these same rates.) Trailers—½ ton capacity or less, $10 plus .1 cent per mi., ½ ton to 1 ton, $15 plus .2 cent per mi., 1 ton to 1½ ton, $25 plus .3 cent per mi., 1½ ton to 1¾ ton, $36 plus .4 cent per mi. (These rates reduced 10 per cent each year of registration up to total of 50 per cent); 1¾ ton to 2 ton, $60 plus .5 cent per mi., 2 ton to 2½ ton, $72 plus .6 cent per mi., 2½ ton to 3 ton, $96 plus .8 cent per mi., 3 ton to 3½ ton, $120 plus 1 cent per mi., 3½ ton to 4 ton, $180 plus 1.5 cents per mi., 4 ton to 4½ ton, $240 plus 2 cents per mi., 4½ ton to 5 ton, $300 plus 2.5 cents per mi. Flat rate for each capacity-class of buses, trucks and trailers covers 12,000 miles, mileage tax accruing on excess mileage rates are increased 25 per cent for vehicles with two or more solid tires. Rating for taxation shall be manufacturers rated seating or carrying capacity; if exceeded, rating shall be on basis of greatest load carried at any one time, except that 10 per cent overload is allowed in emergencies and buses may carry 50 per cent overload for not more than 25 per cent of scheduled trip. Separate classes of tags are provided for vehicles of the several classifications established for tax purposes. Dealers must make monthly reports to State Auditor and County Sheriff of all vehicles sold, giving names and addresses of purchasers. Vehicles not paying foregoing taxes, or not licensed as common carriers by Mississippi Railroad Commission must obtain temporary permit before using highways, permit to show destination, distance traveled and amount of tax (at mileage rate) and be subject to inspection by any officer. Vehicles not having permits are to be taken to nearest Sheriff for collection of tax—minimum fee $2 to $5; sheriff gets 5 per cent of such collections. Operators must keep daily record of mileage. Trucks of 2½ ton capacity or more must have standard speedometers in good condition. Reports of mileage operated must be filed monthly with State Auditor, who administers the act, being authorized to employ five patrolmen and/or auditors; State Highway Commission co-operates in enforcement. Violations to be punished for first offense by enjoinment of both person and vehicle from using highways for not less than one month nor more than six months; second offense, enjoinment for not less than six nor more than twelve months. Penalties for delinquency in making reports or payments to be first lien on vehicle. All provisions of the act apply to private, contract and common carriers.

Missouri

State Agency Exercising Control: Public Service Commission fixes rates, fares, charges, etc., of common carriers of passengers or freight and prescribes maximum but not minimum rates for contract carriers.

Prerequisites of Operation: Certificate of public convenience and necessity for common carriers of passengers or freight—permit for contract carriers, intrastate and interstate; liability insurance policy or bond for common and contract carriers in such sum and upon such conditions as the commission may deem necessary.

Dimensions: Length, single unit, 33 ft., combination, 40 ft.; width, 8 ft.; height, 12½ ft. Weight—within cities of 75,000 or more population—gross weight, single vehicle, 28,000 lb., combination of tractor and semi-trailer (6 wheels), 42,000 lb.; axle weight, 22,400 lb.; weight on tires, 800 lb. per in. tire width; outside cities of 75,000 or more population—gross weight, single vehicle, 24,000 lb., combination of tractor and semi-trailer, 38,000 lb.; axle weight, 16,000 lb.; weight on tires, 600 lb. per in. tire width.

Taxes: Bus license fees—$10 per passenger seat for vehicles operating under certificate of convenience and necessity or interstate permit. License fees for common carrier, trucks, trailers and semi-trailers—1½ to 2 ton, $25, 2 to 3 ton, $65, 3 to 4 ton, $100, 4 to 5 ton, $135, 5 to 6 ton, $175, 6 to 7 ton, $225, 7 to 8 ton, $275, 8 to 9 ton, $350, over 9 ton, $500. (If mileage in month is 10 miles or less—¼ of above fees; if mileage in month is not more than 20 miles—½ of above fees.) Registration fees for buses—less than 12 h.p., $7.50, 12 to 23 h.p., $10.50, 24 to 35 h.p., $16.50, 36 to 47 h.p., $22.50, 48 to 59 h.p., $25.50, 60 to 71 h. p., $31.50, 72 and over, $37.50; registration fees for trucks—less than 2 ton capacity, $10.50, 2 to 5 ton, $18, 5 to 6 ton, $27, 6 to 7 ton, $30, 7 to 8 ton, $36, 8 and over per ton additional, $15; registration fees for trailers 50 per cent of truck fees, for semi-trailers, 25 per cent of truck fees.

Montana

State Agency Exercising Control: Board of Railroad Commissioners fixes rates, fares, etc., of common carriers of passengers or freight.

Prerequisites of Operation: Certificate of public convenience and necessity, for common carriers of passengers or freight; bond or insurance policy to be furnished for passenger and freight in amounts to be fixed by commission.

Dimensions: Length Single Unit, 33ft., Combination, 60 ft.; (maximum length of trailer may be limited by Highway Commission or local authorities where coverture makes same dangerous); width, 8 ft., (farm tractor or load of hay not to exceed 12 ft.), height, 14 ft. Weight: Any 4-wheel vehicle, gross weight, 24,000 lb., (no vehicle permitted more than 16,800 lb. on 1 axle, nor over 800 lb. per in. width of tire); single vehicle with more than 4 wheels, gross weight, 34,000 lb. not over 13,000 lb. on 1 axle. If axles are spaced less than 8 ft. apart the load on one axle is limited to 8,400 lb. *Note:* State Highway Commission or local authorities on application may authorize vehicle of greater sized weight for single trip on designated route and conditions prescribed.

Taxes: All automobiles, buses and trucks are assessed and taxed on actual value; also, all buses and trucks must pay $15 on filing application for certificate to operate and also a fee of $10 upon issuance of certificate, and $10 per year thereafter while operating. (These fees paid to Railroad Commission). Annual registration fees, motor vehicles, other than trucks and buses weighing less than 2,750 lbs., $10, over 2,750 lb. and less than 4,500 lb., $15, 4,500 lb. or over, $25; trucks—not over 1½ ton, $16, 1½ to 2 ton, $22.50, 2 to 3 ton, $37.50, 3 to 5 ton, $60, over 5 tons, $200; buses are classed as trucks and licensed accordingly; trailers or semi-trailers—1½ tons or more, $5; all rates for trucks, trailers or semi-trailers 25 per cent higher when not equipped with pneumatic tires. (Registration fees paid to Registrar of Motors.)

Nebraska

State Agency Exercising Control: Railway Commission has general control of common carriers but cannot fix rates.

Prerequisites of Operation: Liability insurance or indemnity bond in amounts to be fixed by the commission; no certificate of public convenience and necessity required.

Dimensions: Length, single unit, 35 ft., combination, 50 ft.; width, 8 ft.; height, 12 ft. Weight, 1 axle, 16,000 lb.—700 lb. per inch tire width.

Taxes, (Registration Fees): Passenger vehicles for hire—more than 7 passengers, $25 plus $12.50 each additional passenger; commercial trucks—less than 1½ ton, $10, 1½ to 2 ton, $15, 2 to 2½ ton, $30, 2½ to 3 ton, $50, 3 to 3½ ton, $75, 3½ to 4 ton, $100, 4 to 4½ ton, $125, 4½ to 5 ton, $150, 5 to 5½ ton, $175, 5½ to 6 ton, $200, 6 to 7 ton, $225; trailers 50 per cent of truck fees.

Nevada

State Agency Exercising Control: Public Service Commission fixes rates, fares, etc., of common carriers.

Prerequisites of Operation: Certificate of public convenience and necessity; bond or insurance policy to be furnished for reimbursement of passengers and property in case of accident due to neglect; amounts to be fixed by the commission.

Dimensions: Weight, 4 wheels—gross, 25,000 lb., 6 wheels, 3 axles—gross, 38,000 lb. (Passenger vehicles having 2 axles and low pressure pneumatic tires with 6 tires in contact with highway—18,000 lb. per axle.

Taxes: Passenger carriers—flat fee, $50, per passenger, $10. (Allowing 16 inches seating space per passenger). Property carriers—flat fee, $50, per 100 lb. rated capacity, $2. For combination passenger and property carriers a flat rate of $50 plus $10 per passenger capacity plus $2 per 100 lb. property carrying capacity is charged. Also: (a) For every stock passenger car 25 cents per 100 lb. or major fraction thereof computed on the advertised factory weight, together with 125 lb. for every passenger which said vehicle is built to accommodate when loaded to capacity; (b) for every reconstructed or specially constructed passenger car 25 cents per 100 lb. or major fraction thereof, said weight to be actual weight of said vehicle as shown by a public weigh-master's certificate, and in addition 125 lb. for every passenger which said vehicle is built to accommodate when loaded to capacity; (c) for every truck, trailer or semi-trailer 25 cents 100 lb. or major fraction thereof, said weight to be actual weight of said vehicle as shown by a public weigh-master's certificate, and in addition the rated loaded capacity.

New Hampshire

State Agency Exercising Control: Public Service Commission may fix rates, schedules and service of passenger common carriers and towns may make rules as to licensing. No regulation of trucks.

Prerequisites of Operation: Certificate of public convenience and necessity, for passenger common carrier; bond or insurance policy for passenger service in amount $500, per vehicle plus $100. per passenger permitted to be carried.

Dimensions: Length, single unit, 30 ft., combination, 85 ft.; width, 8 ft. Weight, gross,—20,000 lb.; Axle, 15,000 lb.; Tire,—750 lb. per in. width of tire concentrated on surface of road. (May be extended by State Highway Commissioner.)

Taxes: Registration fees based on weight of vehicle and passengers—60 cents per 100 lb., each seat being considered equivalent to 150 lb.; also, additional fees based on the manufacturer's list price of vehicle and decreasing with each year vehicle remains in operation.

New Jersey

State Agency Exercising Control: Board of Public Utility Commissioners. Fixes rates, fares, etc., of passenger common carriers.

Prerequisites of Operation: Within municipalities and out from municipalities—indemnity bonds of $5,000. required by municipalities in which lines operate; into municipalities (over both regular and irregular routes)—bus companies having cash capital of not less than $500,000 need not file indemnity bonds. Permits from each local municipality, which must be approved by Public Utility Commission—buses only.

Dimensions: Length, single unit, 28 ft.; combination, 85 ft.; width, 8 ft.; height, 12½ ft. (Buses under control of Board of Utility Commissioners cannot be equipped with bodies more than 24 ft. in length nor less than 16 ft.; more than 8 ft. in width nor less than 7 ft.; inside clearance not more than 6 ft. 6 in. nor less than 6 ft. 4 in. Length of body may be reduced by municipal authorities. Commercial motor vehicles with a width and/or length greater than the above width and length restrictions may be operated when special permit therefor is obtained from Commissioner of Motor Vehicles.) Weight: 30,000 lb. gross, except over bridges posted for lesser weight; 800 lb. per in. (base) width of tire, specific limits are prescribed for various sizes of tires and wheel diameters; commercial motor vehicles having gross weight exceeding 30,000 lb. may be

operated when special permit is obtained from Commissioner of motor vehicles.

Taxes: Buses—5 passengers or less, $15, 6-8 passengers, $17.50, 9-12 passengers, $20, 13-17 passengers, $25, 18-22 passengers, $30, 23-26 passengers, $35, 27-30 passengers, $40, over 30 passengers, $40 plus $2 per seat in excess of 30. (Municipalities may charge common carriers 5 per cent of gross income, prorated among municipalities in proportion to amount of mileage in each municipality.) Interstate buses pay ½ cent per mile on mileage covered in State. Trucks—gross weight, 1,000 lb. or less, $10, 1,001 to 2,000 lb., $12, 2,001 to 3,000 lb., $15, 3,001 to 4,000 lb., $20, 4,001 to 5,000 lb., $24, per 1,000 lb. over 5,000 lb. up to 30,000 lb. gross, $3.

New Mexico

State Agency Exercising Control: State Corporation Commission fixes rates, schedules, etc., of common carriers.

Prerequisites of Operation: Certificate of public convenience and necessity for common carriers of passenger or freight; bond-in urance policy of indemnity in amounts to be approved by Commission.

Dimensions: Length, single unit, 33 ft., combination, 85 ft.; width, 8 ft.; height, 14 ft.; weight, axle, 18,000 lb.

Taxes: Passenger carriers—for each bus not a common carrier, registration fee $50 plus $10 for each seat of normal seating capacity; common carriers ½ the regular registration fee of private commercial carriers and in addition—7 passengers or less, ¼ cent per mi., 8 to 12 passengers, ½ cent per mi., 13 to 18 passengers, 1 cent per mi., 19 to 25 passengers, 1½ cent per mi., over 25 passengers, 2 cents per mi. Property carriers, commercial trucks registration fees—if not registered in any state last two years, 1600 lb. or less, $18, 1601 lb. to 2400 lb., $18 plus $1 per 100 lb. in excess of 1600 lb., more than 2400 lb., $26 plus $1 per 100 lb. in excess of 2400 lb.; if registered in any state last two years, 1600 lb. or less, $10, 1601 to 2400 lb., $10 plus $1 per 100 lb. in excess of 1600 lb., more than 2400 lb., $18 plus $1.50 per 100 lb. in excess of 2400 lb. Common carriers pay one-half above fees and, in addition, if 1½ ton or less, ¼ cent per mi., 1½ to 2½ ton, ½ cent per mi., 2½ to 4 ton, 1 cent per mi., 4 to 5 ton, 2 cents per mi., over 5 ton, 3 cents per mi. Combination passenger and property carriers pay either the passenger or property rate, whichever will produce the greater revenue; trailers pay ½ the private trailer fee plus the above mileage fee based on capacity. Vehicles with solid rubber tires pay 25 per cent in addition to regular fee—100 per cent additional if solid tires are other than rubber.

New York

State Agency Exercising Control: Public Service Commission fixes rates, fares, etc., of passenger carriers. Transit Commission has jurisdiction in City of New York.

Prerequisites of Operation: Consent of municipal, town and village authorities; certificate of public convenience and necessity for passenger and freight common carriers; indemnity bond or insurance policy for each vehicle in sum of $2500 for personal injuries or death, and $500 for property damage.

Dimensions: Length, single unit or combination, 65 ft.; width, 8 ft. Weight: 4-wheel vehicles, 11,200 lb. on each wheel, 28,000 lb. gross; truck or tractor with 2 wheel trailer, 42,000 lb. gross; 6-wheel vehicles, 9,000 lb. on each wheel, 42,000 lb. gross (pneumatic tires), 36,000 lb. gross (solid tires).

Taxes: Passenger vehicle registration fees—5 passengers or less, $15, 6 to 7 passengers, $24.50, 8 to 10 passengers, $30.50, 11 to 16 passengers, $43, 17 to 20 passengers, $52, 21 to 22 passengers, $55, 23 to 26 passengers, $61.50, 27 to 30 passengers, $67.50, over 30 passengers, $67.50 plus $2.00 for each passenger seat in excess of 30. If operated by electricity not generated by an engine 50 per cent in excess of foregoing rates. Hearses and motor vehicles known as suburban cars—less than 1,800 lb., unladen, $12, 1,800 lb. or more, 75 cents per 100 lb. If suburban car is operated by electricity not generated by an engine 50 per cent in excess of foregoing rates.

Truck fees—light delivery cars having a box, rack or platform on rear or body adapted for carrying goods less than 1800 lbs. unladen, $12; if operated by electricity not generated by an engine 50 per cent in excess of foregoing rates: Tractor any weight and truck weighing 1,800 lb. or more, unladen—annual fee of 80 cents per 100 lbs.; if operated by electricity, $1.20 per 100 lbs. unladen. Semi-trailer, 80 cents per 100 lbs. unladen. Trailer, 1 ton or less, $8, more than 1 ton, $8 each ton or fraction thereof. Effective July 1, 1932 and ending on December 31, 1933 registration fees for motor vehicles used as omnibuses for transportation of passengers having seating capacity of more than 7 passengers except omnibuses operated entirely by electricity not generated by an engine was increased 65 per cent over above fees. Also, fees on any suburban car, tractor or truck not operated entirely by electricity not generated by an engine and weighing more than 2,000 lb. unladen, were increased 65 per cent over above fees. Registration fees for trailers also increased 65 per cent. Certificated carriers in New York also pay a gross revenue tax.

North Carolina

State Agency Exercising Control: Corporation Commission. Fixes rates, fares, etc., of common carriers of passengers or freight.

Prerequisites of Operation: Franchise certificate for motor vehicles operating between fixed termini or over regular routes; indemnity bond or liability insurance in amount of $5,000. to $10.000. for personal injuries and $1,000. for property damage.

Dimensions: Length, single unit, 33 ft., combination, 55 ft.; width, 7½ ft.; height, 12 ft.; weight, gross, 20,000 lb.

Taxes: Certificated motor vehicles, operating between fixed termini or over regular routes, are assessed an annual license fee of 90 cents per 100 lb. weight and, in addition, a franchise tax of 6 per cent of gross revenues. Passenger automobiles operated for hire, but without fixed termini or regular routes, are assessed an annual license fee of $1.90 per 100 lb. weight. Passenger vehicles engaged in sight-seeing or travel tour services are assessed annual license fees based on carrying capacity, as follows: 7 passengers or less, $1.90 per 100 lb. weight; 8 to 15 passengers, $2.50 per 100 lb.; 16 to 25 passengers, $3.50 per 100 lb.; over 25 passengers, $4 per 100 lb. Trucks operated for hire but without fixed termini or regular routes are assessed annual license fees as follows: When operations are within a 75-mile radius—less than 2 ton, $1 per 100 lb.; 2 to 3 ton, $1.25 per 100 lb.; 3 ton and over, $2.00 per 100 lb.; when operated on long-haul service—less than 2 ton, $1.25 per 100 lb.; 2 to 3 ton, $2 per 100 lb.; 3 ton and over, $3 per 100 lb. Trailers operated for hire are assessed as follows: Less than 2 tons $1.50 per 100 lb.; 2 to 3 ton, $2.00 per 100 lb.; 3 ton and over, $4 per 100 lb. Private passenger vehicles are assessed as follows: Up to 7 passengers 90 cents per 100 lb.; more than 7 passengers, $2 per seat. Private truck fees are as follows: When equipped with pneumatic tires—½ to 2 ton, 55 cents per 100 lb. gross wt.; 2 to 3 ton, 70 cents per 100 lb.; 3 to 10 ton, $1 per 100 lb.; when wholly or partially equipped with solid tires—½ to 2 ton, $1.20 per 100 lb. gross wt.; 2 to 3 ton, $1.40 per 100 lb.; 3 to 10 ton, $2 per ton.

Pacific Greyhound Gains in Depression

(*Continued from page 308*)

was caused by the establishment of the bonus for safe driving during 1932. The cost of gasoline in 1932 was $314,514, as compared to $406,905 in 1931.

Station expenses decreased from $617,416 in 1931 to $494,419 in 1932, a reduction in the station expenses per motor coach-mile from 2.6 cents to 2.5 cents. Traffic promotion expenses were reduced from $196,494 in 1931 to $150,463 in 1932. Advertising expenses were reduced from $203,340 to $135,208, although it is notable that, while the Pacific Greyhound Corporation reduced its national advertising in 1932, it increased its local advertising to the extent of $67,447. Insurance and safety expenses were reduced from $252,370 to $200,435, while administration expenses were reduced from $493,275 to $345,390, a reduction on a motor coach-mile basis from 2.0 cents to 1.7 cents.

Operating taxes consumed $477,457 of Pacific Greyhound's revenues in 1932, as compared to $572,202 in 1931. Two of the largest tax items in 1932 were the gasoline taxes, aggregating $133,248, and the public utility taxes, amounting to $279,352. Taxes for 1932 were 2.41 cents per motor coach-mile, as compared to 2.39 cents per motor coach-mile in 1931.

A reduction from 4.7 cents per motor coach-mile to 3.2 cents was made in the charges for depreciation and retirement, the aggregate amounts having been $1,130,521 in 1931 and $640,315 in 1932.

Operating Statistics

The Pacific Greyhound Lines operated 17,804,119 motor coach-miles in 1932 on regular schedules, with an additional 550,162 on extra schedules, 1,122,263 on guaranteed schedules, 97,978 on charter runs, and 216,714 on dead-heading. The average number of buses operated was 317, as compared to 433 in 1931. The total bus-miles per month per bus operated were 4,802 in 1932, as compared to 4,466 in 1931.

During the year, the average number of employees was 1,006, as compared to 1,297 in 1931. The payroll in 1932 was $1,679,824, as compared to $2,385,917 in 1931. The average wage per month per employee was $139.15 in 1932 and $153.30 in 1931.

The company operated 46 of its own stations and 579 commission stations in 1932, as compared to 57 and 679, respectively, in 1931. The ticket sales per month per station on the average were $644.13 in 1932 and $760.47 in 1931. The station cost per month per station was $68.97 in 1932 and $72.53 in 1931, making the per cent of the ticket sales represented by station costs 10.7 per cent in 1932 and 10.3 per cent in 1931.

Indicative of the efficiency of the company's maintenance of its buses are the statistics on road failures. There were 445 of these in 1932, as compared to 715 in 1931. Motor coach-miles per road failure increased from 33,454 in 1931 to 44,523 in 1932.

The effectiveness of the company's safety efforts is shown in the statistics on accidents. The number of accidents in 1932 was 438, less than half of that in 1931 when 984 accidents were recorded. Bus-miles per accident were 45,235 in 1932, as compared to 24,309 in 1931. Passenger fatalities in 1932 were 2, while in 1931 they were 3, making bus-miles per passenger fatality 9,906,419 in 1932, as compared to 7,973,293 in 1931.

In 1932, the Pacific Greyhound motor coaches consumed 3,966,535 gal. of gasoline, getting an average of 4.99 bus-miles per gal. A total of 272,704 qt. of oil were consumed, bus-miles per qt. of oil having been 72.65.

NEWS

Canadian Railway Bill Reported Out in Senate

Committee on Railways refuses to remove disputed compulsory arbitration feature

The Canadian Senate's committee on railways last week reported the bill giving effect to the recommendations of the Royal Commission on Transport and known as "An act respecting the Canadian National Railways and to provide for co-operation with the Canadian Pacific Railway System, and for other purposes."

The committee did not agree with the suggestion of Senator George Lynch-Staunton of Hamilton, Ont., that setting up a tribunal which could compel the Canadian Pacific and Canadian National to co-operate, would impair the credit of the private company in England.

The Hamilton senator supported the view of E. W. Beatty, president of the C. P. R. that it would, and in the committee he unsuccessfully sought to delay the creation of such a tribunal until the railways had an opportunity to show what they could do voluntarily.

The clause in dispute provides for the creation of a tribunal to which either railway could apply to force the other road to co-operate in economies. Its provisions were accepted by the committee after much discussion. Senator Lynch-Staunton moved that this part should not become law until proclaimed by Governor-in-Council—in other words, until the government was satisfied the two systems were not co-operating as much as they should. This would postpone any injury the law might have on C. P. R. credit for the time being.

The committee voted down the proposal 18 to 11, after Rt. Hon. Arthur Meighen (Conservative leader in the Senate) had strongly opposed it.

Lawrence Richardson Heads A. R. A. Committee

Lawrence Richardson, chief mechanical officer of the Boston & Maine, Boston, Mass., has been appointed chairman of the Committee on Automatic Train Control, American Railway Association.

Air Mail Appropriation Restored

The appropriation of $19,000,000 for the Postoffice Department for air mail service for the fiscal year 1934, which was eliminated from the Treasury-Postoffice appropriation bill by the Senate after the bill had been passed by the House, was restored by the conference committee, whose report was adopted by the House on February 21.

Some Pertinent Questions on Motor "Taxes"

Are the taxes paid by telephone companies used to construct copper circuits on which anyone with a telephone instrument may plug in? Do the tax checks written by electric power companies take corporeal form in transmission lines which those companies may use free of toll? What part of the taxes paid by railroads in the past ten or forty years has been applied to experiments in locomotive design? Surely these questions of fact—which this newspaper is content to raise and leave unanswered—have a bearing upon the conception of gas vehicle taxes as a trust fund sacred to the highway.

From an Editorial in the Wall Street Journal

Rail Executives Heard in Depression Inquiry

Loree, Pelley and Atterbury among business men giving views to Senate committee

A comprehensive program for adapting the railroads to changing conditions by a process of "weeding out" and reconstruction applied to both railroads and governmental policies was advocated by L. F. Loree, president of the Delaware & Hudson, in a statement on the relation of the railroads to the causes and cures of the commercial depression before the Senate finance committee on February 18. While other congressional committees are investigating particular phases of the present situation this committee has recently undertaken an investigation of the depression itself, and had invited a long list of prominent witnesses to testify as to their views of the causes and remedies.

Mr. Loree said that "in our present troubles the two outstanding dislocations are taxes and wages" and that if the railroads were "turned loose" they would very soon "straighten themselves out." Advocating a policy of pruning waste facilities and improving and developing the railroad mileage that handles the bulk of the traffic he estimated that probably two and a half billions of railroad investment could be charged off, and, expressing the opinion that the short-haul passenger business is permanently lost to the passenger

(*Continued on page 317*)

Small Risk for R. F. C. in Rail Loans, says Shoup

Total is less than unrecoverable highway aid appropriations of past two years

Not through panaceas but through the confidence inspired by adhering to basic, time-tested principles of economics and government can we bring a return to normal conditions in business and industry, declared Paul Shoup, vice-chairman of the Southern Pacific, in his address on February 21 at the twenty-sixth annual banquet of the Traffic Club of New York.

Reviewing the record of the railways over the past eleven years, Mr. Shoup said that the Reconstruction Finance Corporation is not assuming much risk on the loans which the rail carriers have received—for which they have given adequate security—and which will be repaid. These loans, he said, aggregate less than the amount of federal aid to state highways during the last two years, and which will not be repaid. His address follows in part:

"The Reconstruction Finance Corporation has saved us from calamity. Its wise administration will make of it in history the greatest single legislative action of our time. It needs to be boldly administered since its only excuse for being is that an emergency has to be met with which normal measures cannot cope. It is especially necessary that the Reconstruction Finance Corporation be supported by public opinion in making loans on character as well as on collateral. The earning record of a railroad, the soundness of its financial structure, and its prospects may well justify a loan even though it has no collateral in its treasury.

"The financial structures of the railroads as a whole are not unsound. Half of their value is represented by stock. They have demonstrated under rather difficult conditions during the past ten years their ability to pay interest and sinking funds and to refund their obligations when they came due. It is far better, where history and prospects justify, that reorganizations, if desirable, await a more prosperous time which is sure to come so that the equities of owners may not be wiped out because of this temporary period of adversity. We need not criticize but we must scrutinize that eagerness of mind which in an effort to meet a temporary situation may in proposed reorganizations create a permanent injustice.

"All history teaches us that we should avoid panaceas. Already we have the

(*Continued on page 318*)

Woodlock Suggests That I. C. C. Usurps Power

Sees "large principle" in merger permit requiring U. P. to acquire short lines

Former Interstate Commerce Commissioner Thomas F. Woodlock, writing in the Wall Street Journal, in commenting upon the recent order of the Interstate Commerce Commission permitting the Union Pacific to lease subsidiaries provided it will acquire certain short lines, says that the decision raises a question as to whether a regulative body "may use the powers delegated to it, which are specific, to force by indirection something which it has not power directly to grant." His observations, in part, are as follows:

"Little matters sometimes involve large questions and large principles. A large question and a large principle are involved in the disposition by the Interstate Commerce Commission of a recent application by the Union Pacific Railroad to 'unify' its system by formal leases of its principal subsidiaries, and it is emphatically 'in the public interest' that both should be clearly recognized.

"The Union Pacific applied to the Commission to lease the properties of the Oregon Short Line, the Oregon-Washington Railroad & Navigation, the Los Angeles & Salt Lake, and the St. Joseph & Grand Island, all of which companies had long been owned by the Union Pacific. It estimated that it would save some $600,000 a year by the leases. The Commission granted the application conditional upon the Union Pacific acquiring (at 'commercial value') two short lines connecting with its system, these lines having requested this condition.

"Either the Commission *has* authority from Congress to compel one railroad system to purchase another—or it *has not*. If it has such authority, it has no need to exercise it in a roundabout way, by making it a condition precedent to a grant of permission to do something unrelated to that purchase. If it *has not* authority to compel such purchase, it has no right to effect its compulsion by making it a condition precedent to grant or permission to do something else and unrelated.

"There is here a dilemma. Even if it be granted that it is desirable 'in the public interest' that these two lines should be acquired by Union Pacific, the dilemma is not resolved. It is the matter of the use of executive power that is in doubt. The question is whether a regulative body may use the powers delegated to it, which are specific, to force by indirection something which it has not power directly to exact. There is but one possible answer to that question—if it can be conceded, as no doubt it will, that our government is a government of laws and not of men—and that answer is, 'No.' Compulsion thus achieved is in essence a usurpation of power, a thing which is wholly inadmissible—intolerable, in fact—in a political system such as ours.

"Unfortunately, there apparently is no direct way open to get the question before the Court—so far as this writer knows. If in this he is mistaken, so much the better, and to Court it should go. We are clearly facing a time when 'regulation' will assume a greater importance in many of our economic relations. It is imperative that we turn a keen and jealous eye at all times on the acts of our 'regulative' bodies and check with an iron hand all attempts at usurpation of powers by our administrative officials. The most real and proximate dangers to our liberties lie in that direction, and it is supremely 'in the public interest' that they be early recognized and sternly stopped at the first ditch."

Senate Committee Approves St. Lawrence Seaway Treaty

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Taxpayers Organize in Bloomington

A McLean County unit of the Illinois Railroad Employees' and Taxpayers' Association was formed at Bloomington, Ill., on February 17, when 1,000 railroad employees and their friends gathered at a mass meeting to protest the use of tax money in subsidizing truck and waterway competition with railroads. Ten thousand signatures were affixed to petitions voicing opposition to the competition of the Federal Barge Line service and to subsidies given to truck and motor coach lines in the form of costly highways.

Urge Motor Transport Control in Dominion

Maritime statesman makes plea in Senate—Meighen suggests conference

Urging early action on the part of the Dominion and provincial governments to eliminate unfair competition between motor transport and the railways, Hon. Walter E. Foster, former Premier of New Brunswick, speaking in the Canadian Senate last week at Ottawa demanded reasonable protection for the railways from the incursions upon their traffic of truck and bus. Senator James H. King, a Liberal of British Columbia, strongly supported Senator Foster's motion for early action, but after Senator Arthur Meighen, Government leader, promised consideration of another conference between the Dominion and the provinces on the question of regulation, the motion was withdrawn.

Senator Foster said, in part: "The railways do not complain much of water competition. Nevertheless there is undoubtedly considerable competition prevailing between the waterways of the country and the railways. In the Canada Year Book for 1932 reference is made to the fact that the opening of the New Welland Ship Canal had caused the traffic in iron ore from Point Edward to Hamilton to be diverted from all-rail to water. Formerly this movement took place over the Canadian National. By reason of the construction of the Welland Canal, the cost of which is estimated at about $200,000,000, and which is operated without regulation and without charge, a large volume of the trade which originally moved over the Canadian National has been diverted to the waterways. There should be some way of preventing competition between Government-owned utilities.

"The National Transportation Commission of the United States, headed by the late Calvin Coolidge, contends that inland waterways should be made to pay their own way. I have thought it timely to mention the competition of the waterways and to stress my belief that the control of our waterways, as well as of other avenues of transportation which enter into competition with the railways, should be given consideration.

"When the idea was first conceived of entering into the construction of these roads on a large scale, it was not intended that they should be exploited for commercial purposes by the owners of heavy vehicles. The idea was to construct a highway, which was not too costly, for the use of private motor car owners and of tourists. But the evolution of motor transport has brought with it heavier vehicles, and has placed upon the shoulders of the taxpayers and the governments of the various provinces, by reason of the wear and tear upon the roads, a very much heavier burden than was originally anticipated. I do not know that, within limitations, there can be any objection to the use of highways for the purposes to which they are now being put; but the burden of which I speak has now reached such proportions

It is understood also that the proponents of legislation to authorize the President to regroup, co-ordinate, consolidate, transfer, or abolish executive or administrative agencies of the government or their functions have in mind that the Interstate Commerce Commission would come under its provisions, although the language of the bill refers to offices and establishments "in the executive branch of the government" and it has been held that the commission is in the legislative branch of the government, although it is appointed by the President and has some executive functions. This legislation was adopted by the Senate as an amendment proposed by Senator Byrns to the Treasury-Postoffice bill, after the bill had been passed by the House, and has been under consideration this week by a conference committee, whose report was adopted by the House on Tuesday.

Texas & New Orleans Suspends A. T. C.

On petition of the company, the Interstate Commerce Commission has suspended until further order its orders requiring the maintenance of automatic train-stop devices on the Texas & New Orleans (Southern Pacific) between Rosenburg and San Antonio, Tex., 170 miles. This road has had automatic train control, the National Safety Appliance Company's intermittent magnetic induction system, in operation since 1927, with a total of 71 locomotives equipped. The reasons for requesting relief are in general the same as those presented by other roads whose cases have been decided within the past year, and with which the reader is familiar. Traffic density on 50 miles of this section has decreased about 29 per cent; on 33 miles, 49 per cent; and on 87 miles, 47 per cent. There have been 1,562 undesired brake applications, not due to the fault of enginemen. Besides the great decline in freight traffic, due to the business depression, reroutings of freight, made possible by the acquisition of other lines, have lessened train movements over this line; diversion of freight to the Panama Canal, and oil to pipe lines have been important causes of lessened income. The advent of good roads has taken large quantities of cotton, rice and other things from the railroad between Houston and San Antonio. Earnings at present are not sufficient to meet operating expenses and taxes. The cost of installation and maintenance of automatic train control is out of proportion to the increase of safety afforded.

The road has made large expenditures for safety in other directions. Automatic block signal mileage in 1921 was 718 miles; now over 1,620 miles; and the company expects, when funds are available, to make other extensive installations; Houston to Shreveport, 230 miles; Giddings to Hearne, 58 miles, Garrett to Fort Worth, 52 miles. On this company's lines there are 369 crossings of railroads at grade, of which only 165 have interlocking; of 4,555 highway grade crossings, only 239 have signals or gates; crossing improvements toward which the road will have to pay $152,000, are already planned for. The discontinuance of automatic train control will result in probable savings of $12,420 annually. The highest rate of passenger train schedules is 41.6 m. p. h. No collisions or other accidents have been prevented by A. T. C. so far as known.

Continuation of Freight Surcharge Urged

Oral arguments were heard by the Interstate Commerce Commission on February 17 on the petition of the railways for a continuation beyond March 31 of the emergency surcharge increase in freight rates allowed by the commission last year in lieu of the 15 per cent general increase which had been asked in Ex Parte No. 103. Comparatively few representatives of shippers appeared in opposition and the argument was concluded in less than one day, but many written statements in opposition had been filed by those who were not represented at the argument.

Alfred P. Thom, general counsel of the Association of Railway Executives, made a brief argument in support of the railroad petition, saying that the surcharges alone represented 20 per cent of the net railway operating income of the carriers for the first nine months of 1932 and that failure to continue them would mean general reductions in revenues which the carriers are in no position to stand. For the year 1932 they amounted to approximately $62,000,000. The surcharges, representing only 2.6 per cent of the gross freight revenues of the carriers, he said, do not constitute a burden which general industry may not reasonably bear in an effort to tide the carriers through the present emergency; and they should be permitted to remain in effect during the emergency, which means an indefinite time. It would be reasonable to permit the railroads that earn the surcharge to keep it, he said, because in nearly all cases they will need it to meet their own fixed charges.

Organizations represented in the argument in opposition included: California Citrus League, American Feed Manufacturers' Association, Schwill & Co., Northern States Power Company, Maher Coal Bureau, South Chicago Coal & Dock Company, National Coal Association, Missouri Highway Commission, and International Apple Association.

William Z. Ripley Retires from Harvard Professorship

William Z. Ripley, Nathaniel Ropes professor of political economy at Harvard University, will retire effective March 1, and will be appointed professor emeritus. Professor Ripley, who is a director of the Chicago, Rock Island & Pacific and a well-known railroad authority was born at Medford, Mass., on October 13, 1867, and received his A.B. degree at Massachusetts Institute of Technology in 1890. He obtained his A.M. and Ph.D. degrees from Columbia University in 1892 and 1893, respectively, and in 1929 he received an Litt. D. degree from the same university. Professor Ripley was awarded LL.D. degrees by the University of Wisconsin in 1930, and by Bucknell and the University of Rochester in 1931. From 1895 to 1901 he was professor of economics at Massachusetts Institute of Technology and during the same period he was also lecturer on sociology at Columbia. Since 1901 he has been a member of the faculty at Harvard. He was appointed professor of political economy in 1902, and in 1911 to the Nathaniel Ropes chair. From 1900 to 1901, he was expert agent on transportation for the United States Industrial Commission and he was Huxley memorial lecturer at Royal Anthropology Institute, London, Eng., in 1908. In 1898, 1900 and 1901 he served as vice-president of the American Economics Association and last December was elected president. In 1918 he was administrator of labor standards for the War Department and for the following two years was chairman of the National Adjustment Commission of the United States Shipping Board. From 1920 to 1923 he served with the Interstate Commerce Commission as special examiner on the consolidation of railroads in which connection he prepared the Commission's tentative consolidation plan which was published in 1921. Among the books by Professor Ripley are "Main Street and Wall Street," "Trusts, Pools and Corporations," "Railway Problems," "Railroads-Rates and Regulations" and "Railroads-Finance and Organization."

Crossing Smash-Ups Analyzed

The record of highway crossing accidents on the Louisville & Nashville for the year 1932 shows that in 38 per cent of the accidents the vehicles ran into the sides of trains occupying crossings; and that in one-third of the remaining 62 per cent of the cases, in which vehicles were struck by trains, the vehicles were stalled on the tracks. Most of the latter cases, it is stated, happened at night in locations where the visibility of the enginemen was limited; and in practically none of them did the drivers of the vehicles make any intelligent attempts to warn the approaching trains of the dangerous obstructions on the tracks. Forty-one per cent of the total of 22 deaths resulting from accidents at crossings on this road, in 1932, occurred in such cases.

R. F. C. Loans to Railroads

Only one loan to a railroad was made by the Reconstruction Finance Corporation in January, according to its monthly report made public on February 20. This listed a total of 105 loans, aggregating $340,435,093, to 62 railroads, which had been authorized, whereas its report for the year ending December 30 had shown $347,435,093 to the same number of roads. The corporation had authorized $3,000,000 for the Missouri Pacific just before February 1, of the $3,800,000 which had been approved by the Interstate Commerce Commission on January 4. The commission had also approved a loan of $1,500,000 to the receivers of the Seaboard Air Line, a loan of $600,000 to the Meridian & Bigbee River, and an additional loan of $11,127,700 to the Chicago & North Western, in January. An additional loan of $5,000,000 to the Baltimore & Ohio, and an additional loan of $273,000 to the St. Louis Southwestern were approved by the commission early in February. It was stated on February 10 at a hearing before Senator Couzens that action on railroad loans had

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that it is questionable whether the provinces will be able to continue to maintain the highways in passable condition without increasing taxes to an extent that I for one should not like to see.

"I believe, honorable gentlemen, that we should endeavor to limit commercial transportation in such a way that only that portion of it which is of real economic value should be permitted to increase in volume."

Mobile & Ohio Employees Vote to Strike

Employees of the Mobile & Ohio have voted to strike unless the wage question, involving a 20 per cent reduction, can be settled by mediation. Ernest E. Norris, receiver for the railroad, at the conclusion of a final conference held with representatives of the brotherhoods, invoked the law governing wage disputes and submitted the case to the United States board of mediation, which will hear testimony.

Trespasser Casualties Increase

The record of trespassers killed and injured on the lines of the Southern Railway in the year 1932—192 killed and 227 injured—shows the remarkable increase of 90 per cent in the deaths and 44½ per cent in the injuries of trespassers on trains; the totals in this class being 78 killed and 156 injured, as compared with 41 killed and 108 injured in 1931; "a natural result," says the road's statement, "of the general prevalence of unauthorized train riding in 1932."

N. R. A. A. Annual Meeting

The annual meeting of the National Railway Appliances Association will be held in the offices of the association, 910 South Michigan Avenue, Chicago, at 11 A. M. on Monday, March 13, to elect officers for the ensuing year and to transact any other business that may come before the meeting. This meeting is held at this time by reason of the fact that the annual exhibit, which is customarily presented at the Coliseum during the convention of the American Railway Engineering Association, has been postponed for this year.

Mileage on Private Cars

Proposals of the Transportation Division of the American Railway Association to reduce the mileage paid by the railroads for the use of privately owned freight cars will be discussed at a conference of the board of directors of that association with the car owners and others at the Drake Hotel in Chicago on March 22. The proposals were discussed by the directors of the American Railway Association in New York last week but the matter was deferred in order to give the private car owners an opportunity to express their views.

Joint Trackage in Northwest Proposed

Plans for the joint use of certain track facilities by the three northern transcontinental carriers to effect economies, now reaching the final stage of negotiations, provide for the pooling of trackage of the Chicago, Milwaukee, St. Paul & Pacific and the Northern Pacific through a large part of Montana to create a more direct joint route. The routing of Northern Pacific passenger trains through the Union Station at Spokane, Wash., and the closing of the Northern Pacific station in that city is also proposed. The Great Northern is involved in the studies as regards the joint use of certain branch line facilities.

Substitution of Motor Mail Transportation Authorized

The Senate on February 9 passed the bill previously passed by the House authorizing the Postmaster General, in his discretion, to permit railroad and electric-car companies to provide mail transportation by motor vehicle over highways in lieu of service by rail, the compensation for such service to be at a rate not in excess of the rate that would be allowed for similar service by railroad or by electric car. The committee report on the bill stated that on account of unprofitable operation certain railroads are withdrawing local train service and substituting buses and that this bill will enable them to provide mail service by bus.

Club Meetings

The Car Foremen's Association of Chicago will hold its next meeting on Monday evening, March 13 at the Auditorium Hotel, Chicago. The discussion will be on the proposed interchange rules.

The Northwest Car Men's Association (St. Paul) will hold its next meeting at the Y. M. C. A. Building, Minnesota Transfer, on Monday evening, March 6. The discussion will be on the proposed changes in interchange rules.

The Southern and Southwestern Railway Club will hold its next meeting at the Ansley Hotel, Atlanta, Ga., on Thursday, March 16, at 10 A. M. Robert Burgess of the Westinghouse Airbrake Company will speak on the A. B. Freight-car brake equipment.

C. P. R. Net 20 Millions in 1932

Net operating revenue of the Canadian Pacific for 1932 amounted to $20,089,984, which compares with a net in 1931 of $25,424,766, a decrease of $5,334,781, while gross revenues for the past year at $123,936,713 showed a decrease of $23,909,405 from the gross of $147,846,118 reported for 1931. Operating expenses at $103,846,729 for 1932 showed a decrease of $18,574,624 from the $122,421,352 reported for 1931.

In December net amounted to $2,310,749, a decrease of $1,279,813 from December of the preceding year, while gross of $9,701,199 showed a decrease of $2,050,027 from the $11,751,227 reported for December of 1931.

Wage Negotiations in Canada

On February 23 general chairman of the train and enginemen's brotherhoods in Canada were to convene to re-open negotiations with the railways with respect to the latter's proposal for a 20 per cent reduction in wage rates to replace on March 1 the 10 per cent reduction now in effect.

The union chiefs were to have canvassed the vote of the local divisions on the question on February 22.

Should a majority of the membership reject the added reduction, the companies will be informed of the decision of the membership at large and negotiations will begin again.

Should the two groups fail to agree, it is expected that the usual procedure, namely, the appointment of a board of conciliation, will follow.

Locomotive Shipments in 1932

Shipments of railroad locomotives from the country's principal manufacturing plants during 1932, as reported to the United States Department of Commerce, totaled 105 locomotives as compared with 166 in 1931 and 820 in 1930. Of the 1932 total, 39 were steam locomotives and 66 electric, including export shipments of seven of the former type and eight of the latter.

For the month of December, 1932, shipments of six locomotives were reported as compared with eight in the previous month and two in December, 1931. Unfilled orders at the end of December totaled 73 locomotives (one steam and 72 electrics) as compared with unfilled orders at the end of December, 1931, for 176 locomotives (39 steam and 137 electrics).

Air Lines Increase Passenger Traffic

American-operated air lines carried 540,681 passengers in the calendar year 1932, an increase of 18,000 over the previous year, according to an announcement by Col. Clarence M. Young, Assistant Secretary of Commerce for Aeronautics. Air express also increased in volume, but air mail declined during the year. Of these passengers 474,279 traveled on the domestic air lines and 66,402 on American-operated air lines extending into Canada and Latin America. Air express amounted to 1,600,821 pounds in 1932, as compared with 1,151,348 pounds in 1931. Air mail carried on the domestic lines as reported by the Post Office Department amounted to 7,393,257 lb. in 1932, as against 9,097,411 lb. in 1931. The compilation for foreign air mail has not yet been completed. Miles flown by all operators in 1932 totaled 50,932,967, as compared with 47,385,987 in 1931. Passenger-miles were 146,552,587 in 1932 as against 119,968,577.

Low Coal Rates to Compete with Trucks

An experimental rail rate for coal haulage to permit competition with motor trucks has been authorized for a period of six months by the Kentucky Railroad Commission. The rate applies to shipments of coal from the Harlan, Jellico, McRoberts and Hazard mines to Richmond, Berea, Ravenna, Hopkinsville, Middlesboro and Irvine. The new rate is $1 a ton from the Hazard fields and $1.09 from the Harlan mines, as compared with the old rate of $1.53 and $1.62, respectively. The change was asked for by the Louisville & Nashville, the Illinois Central and the Southern and is authorized for all railroads in the state. According to data submitted by the Louisville & Nashville in its petition, rail shipments of coal from Southeastern Kentucky fields into Richmond have shown a steady decline in the

past four years. The Traffic committee of the Richmond Chamber of Commerce estimates that more than 200 tons of coal are brought into and through Richmond each day by trucks. These figures are based on actual counts made on roads leading into and through the city.

Freight Volume for 1932

Freight moved in 1932 by the railroads totaled 259,004,372,000 net ton-miles for the 12 months, according to reports compiled by the Bureau of Railway Economics. This was a reduction of 81,144,250,000 net ton-miles, or 23.9 per cent, under the total for 1931 and a reduction of 163,128,319,000 net ton-miles, or 38.6 per cent, under 1930. In the Eastern district, the reduction was 22 per cent; in the Southern district 25 per cent, and in the Western 26.1 per cent.

The record for December showed 21,101,728,000 net ton-miles, a reduction of 1,560,692,000 net ton-miles, or 6.9 per cent below that of the same month in 1931 and a reduction of 27.3 per cent under December, 1930. The Eastern district in December showed 3 per cent below the same month the year before, and the Southern district 3.5 per cent below; while in the Western district the decline was 13.8 per cent.

Bus Tours for Rail Passengers

The Southern Pacific has entered into an arrangement with California Parlor Car Tours, under which passengers going to California by Southern Pacific trains may avail themselves of the motor coach tour service of California Parlor Car Tours at a reduced rate. The latter company operates a three-day motor tour to scenic points in the state, the regular rate for which, on an all-expense basis, is $47.50. Under the new plan, the holders of tickets good for transportation over the Southern Pacific between San Francisco and Los Angeles will be given the benefit of a special fare for the tour of $42.50. California Parlor Car Tours is a subsidiary of the Pacific Greyhound Corporation, in which the Southern Pacific has a large stock interest.

Livestock Rate Hearing Adjourns

The hearing on sale-in-transit rates on livestock, which opened at Chicago on February 13 before Examiner William A. Disque of the Interstate Commerce Commission, as reported on page 257 of the *Railway Age* of February 18, adjourned on February 18 until February 27, when additional railroad witnesses will be heard. Witnesses heard at Chicago last week included L. E. Wettling, statistician for the Western Lines, A. F. Cleveland, vice-president of the Chicago & North Western, George Hoffelder, assistant general freight agent of the Chicago, Burlington & Quincy, and J. E. Davis, assistant to the freight traffic manager of the Union Pacific. Mr. Wettling portrayed the financial condition of the western lines, testifying that in 1932 their net operating income was equivalent to a rate of return of only 0.59 per cent on the investment. Mr. Cleveland contended that it would be impossible for the railroads to continue the existing service if transit privileges were granted, that even a substantial reduction in livestock rates would make such a trifling difference in the retail price of meat that it would not increase consumption sufficient to influence the volume of the tonnage and that if transit rates were to be established, the entire basis of rates should be changed simultaneously. Mr. Hoffelder estimated that the granting of sale-in-transit rates would cost the western lines about $4,000,000 annually, and that the establishing of slaughter-in-transit rates would take another $8,000,000.

Southern Lines Offer Store-Door Service

Store-door pick-up and delivery of l. c. l. freight will soon be offered by the Louisville & Nashville, the Nashville, Chattanooga & St. Louis, the Gulf, Mobile & Northern, the New Orleans Great Northern and the Tennessee, Alabama & Georgia. Under the new tariff, which is expected to go into effect about March 15, there will be no charge for pick-up and delivery service on shipments moving less than 230 miles. Shipments moving a greater distance will be picked up and delivered by the railroad, if this service is desired, at an extra charge of 10 cents per 100 lb. The railroads have entered into contracts with truck operators in the towns where the service will be available, to provide the trucks necessary for the performance of the pick-up and delivery work.

Railways Oppose Expenditures For Cumberland River Improvement

Representatives of the Illinois Central, the Louisville & Nashville, the Tennessee Central, and the Gulf, Mobile & Northern, and of organizations of their employees, appeared at a hearing before the Board of Engineers for Rivers and Harbors at Washington on February 13 in opposition to the recommendations of the United States district engineer at Nashville proposing that the federal government immediately expend over $850,000 to improve the Cumberland river in Kentucky and Tennessee for navigation purposes. Dr. C. S. Duncan, economist of the Association of Railway Executives, also made a general statement of the views of the railways on the general subject of waterway improvements, stating that the entire program of inland waterway development is now being subjected to skeptical inquiry and that "it would seem the part of wisdom that no further commitments should be made in the direction of carrying out a program that is under economic suspicion until a new survey of the situation has been made."

President Hoover Urges Passage of Bankruptcy Bill

Enactment during the present session of Congress of the bankruptcy bill, with its provision for railroad reorganization without receivership, was urged by President Hoover in a special message to Congress on February 20 as one of several measures looking to the promotion of economic recovery which he said are so advanced toward completion or understanding as to seem possible. It is most necessary, he said, that the principles of this bill, which has already been passed by the House, should be passed by the Senate, and he referred to the legislation as "of the most critical importance in this period of readjustment." "Incidentally," he said, "such a workable system is highly necessary in order to permit a certain minority of railroads to be so reorganized as to reduce fixed charges and thus relieve the Reconstruction Finance Corporation of drains in prevention of destructive receiverships." The bill had been reported to the Senate by the judiciary committee without the provisions for railroad and corporate reorganization which were in the bill as passed by the House but plans had been made for an effort to add the railroad section by amendment during its consideration in the Senate. The bill was reached as the unfinished business of the Senate shortly after receipt of the President's message but it was temporarily laid aside to permit consideration of the independent offices appropriation bill.

The President also said that the St. Lawrence seaway treaty should be ratified on the ground that "it not only will serve a great national purpose but is of importance now also to relieve unemployment by its construction."

Engineering Week at Chicago, June 25-30

Plans are now being consummated for a conference of engineers at Chicago, during Engineering Week, June 25-30, sponsored by the Century of Progress Exposition. Included on the program are the sessions of the American Society of Mechanical Engineers, the American Society of Refrigerating Engineers and the American Society of Heating and Ventilating Engineers. The Railway division of the A. S. M. E. is arranging for one session.

In addition to exhibits at the Century of Progress Exposition, railway engineers will be interested in the Sixth Midwestern Engineering and Power Exposition, to be held at the Coliseum during that week. At this latter manufacturers will exhibit steam generating equipment for power and heating purposes. In addition there will be shown machinery such as ventilating and air-conditioning, refrigeration equipment, pumps, electrical apparatus, etc.

I. C. C. Bill Passed by House

The House on February 20 passed with practically no debate the bill giving the Interstate Commerce Commission the authorization it has been seeking for several years to assign or refer any portion of its work to an individual commissioner or to a board composed of an employee or employees for action thereon. This authority would not, however, extend to investigations instituted upon the commission's own motion, nor, without the consent of the parties, to contested proceedings involving the taking of testimony at public hearings. Any action taken by such individual commissioner or board would have the same force and effect as if taken by the commission, but any party affected could file a petition for reconsideration or rehearing by the commission or a division thereof. The bill was then referred to the Senate.

It is understood also that the proponents of legislation to authorize the President to regroup, co-ordinate, consolidate, transfer, or abolish executive or administrative agencies of the government or their functions have in mind that the Interstate Commerce Commission would come under its provisions, although the language of the bill refers to offices and establishments "in the executive branch of the government" and it has been held that the commission is in the legislative branch of the government, although it is appointed by the President and has some executive functions. This legislation was adopted by the Senate as an amendment proposed by Senator Byrns to the Treasury-Postoffice bill, after the bill had been passed by the House, and has been under consideration this week by a conference committee, whose report was adopted by the House on Tuesday.

Texas & New Orleans Suspends A. T. C.

On petition of the company, the Interstate Commerce Commission has suspended until further order its orders requiring the maintenance of automatic train-stop devices on the Texas & New Orleans (Southern Pacific) between Rosenburg and San Antonio, Tex., 170 miles. This road has had automatic train control, the National Safety Appliance Company's intermittent magnetic induction system, in operation since 1927, with a total of 71 locomotives equipped. The reasons for requesting relief are in general the same as those presented by other roads whose cases have been decided within the past year, and with which the reader is familiar. Traffic density on 50 miles of this section has decreased about 29 per cent; on 33 miles, 49 per cent; and on 87 miles, 47 per cent. There have been 1,562 undesired brake applications, not due to the fault of enginemen. Besides the great decline in freight traffic due to the business depression, reroutings of freight, made possible by the acquisition of other lines, have lessened train movements over this line; diversion of freight to the Panama Canal, and oil to pipe lines have been important causes of lessened income. The advent of good roads has taken large quantities of cotton, rice and other things from the railroad between Houston and San Antonio. Earnings at present are not sufficient to meet operating expenses and taxes. The cost of installation and maintenance of automatic train control is out of proportion to the increase of safety afforded.

The road has made large expenditures for safety in other directions. Automatic block signal mileage in 1921 was 718 miles; now over 1,620 miles; and the company expects, when funds are available, to make other extensive installations; Houston to Shreveport, 230 miles; Giddings to Hearne, 58 miles, Garrett to Fort Worth, 52 miles. On this company's lines there are 369 crossings of railroads at grade, of which only 165 have interlocking; of 4,555 highway grade crossings, only 239 have signals or gates; crossing improvements toward which the road will have to pay $152,000, are already planned for. The discontinuance of automatic train control will result in probable savings of $12,420 annually. The highest rate of passenger train schedules is 41.6 m. p. h. No collisions or other accidents have been prevented by A. T. C. so far as known.

Continuation of Freight Surcharge Urged

Oral arguments were heard by the Interstate Commerce Commission on February 17 on the petition of the railways for a continuation beyond March 31 of the emergency surcharge increase in freight rates allowed by the commission last year in lieu of the 15 per cent general increase which had been asked in Ex Parte No. 103. Comparatively few representatives of shippers appeared in opposition and the argument was concluded in less than one day, but many written statements in opposition had been filed by those who were not represented at the argument.

Alfred P. Thom, general counsel of the Association of Railway Executives, made a brief argument in support of the railroad petition, saying that the surcharges alone represented 20 per cent of the net railway operating income of the carriers for the first nine months of 1932 and that failure to continue them would mean general reductions in revenues which the carriers are in no position to stand. For the year 1932 they amounted to approximately $62,000,000. The surcharges, representing only 2.6 per cent of the gross freight revenues of the carriers, he said, do not constitute a burden which general industry may not reasonably bear in an effort to tide the carriers through the present emergency; and they should be permitted to remain in effect during the emergency, which means an indefinite time. It would be reasonable to permit the railroads that earn the surcharge to keep it, he said, because in nearly all cases they will need it to meet their own fixed charges.

Organizations represented in the argument in opposition included: California Citrus League, American Feed Manufacturers' Association, Schwill & Co., Northern States Power Company, Maher Coal Bureau, South Chicago Coal & Dock Company, National Coal Association, Missouri Highway Commission, and International Apple Association.

William Z. Ripley Retires from Harvard Professorship

William Z. Ripley, Nathaniel Ropes professor of political economy at Harvard University, will retire effective March 1, and will be appointed professor emeritus. Professor Ripley, who is a director of the Chicago, Rock Island & Pacific and a well-known railroad authority was born at Medford, Mass., on October 13, 1867, and received his A.B. degree at Massachusetts Institute of Technology in 1890. He obtained his A.M. and Ph.D. degrees from Columbia University in 1892 and 1893, respectively, and in 1929 he received an Litt. D. degree from the same university. Professor Ripley was awarded LL.D. degrees by the University of Wisconsin in 1930, and by Bucknell and the University of Rochester in 1931. From 1895 to 1901 he was professor of economics at Massachusetts Institute of Technology and during the same period he was also lecturer on sociology at Columbia. Since 1901 he has been a member of the faculty at Harvard. He was appointed professor of political economy in 1902, and in 1911 to the Nathaniel Ropes chair. From 1900 to 1901, he was expert agent on transportation for the United States Industrial Commission and he was Huxley memorial lecturer at Royal Anthropology Institute, London, Eng., in 1908. In 1898, 1900 and 1901 he served as vice-president of the American Economics Association and last December was elected president. In 1918 he was administrator of labor standards for the War Department and for the following two years was chairman of the National Adjustment Commission of the United States Shipping Board. From 1920 to 1923 he served with the Interstate Commerce Commission as special examiner on the consolidation of railroads in which connection he prepared the Commission's tentative consolidation plan which was published in 1921. Among the books by Professor Ripley are "Main Street and Wall Street," "Trusts, Pools and Corporations," "Railway Problems," "Railroads-Rates and Regulations" and "Railroads-Finance and Organization."

Crossing Smash-Ups Analyzed

The record of highway crossing accidents on the Louisville & Nashville for the year 1932 shows that in 38 per cent of the accidents the vehicles ran into the sides of trains occupying crossings; and that in one-third of the remaining 62 per cent of the cases, in which vehicles were struck by trains, the vehicles were stalled on the tracks. Most of the latter cases, it is stated, happened at night in locations where the visibility of the enginemen was limited; and in practically none of them did the drivers of the vehicles make any intelligent attempts to warn the approaching trains of the dangerous obstructions on the tracks. Forty-one per cent of the total of 22 deaths resulting from accidents at crossings on this road, in 1932, occurred in such cases.

R. F. C. Loans to Railroads

Only one loan to a railroad was made by the Reconstruction Finance Corporation in January, according to its monthly report made public on February 20. This listed a total of 105 loans, aggregating $340,435,093, to 62 railroads, which had been authorized, whereas its report for the year ending December 30 had shown $347,435,093 to the same number of roads. The corporation had authorized $3,000,000 for the Missouri Pacific just before February 1, of the $3,800,000 which had been approved by the Interstate Commerce Commission on January 4. The commission had also approved a loan of $1,500,000 to the receivers of the Seaboard Air Line, a loan of $600,000 to the Meridian & Bigbee River, and an additional loan of $11,127,700 to the Chicago & North Western, in January. An additional loan of $5,000,000 to the Baltimore & Ohio, and an additional loan of $273,000 to the St. Louis Southwestern were approved by the commission early in February. It was stated on February 10 at a hearing before Senator Couzens that action on railroad loans had

been postponed in several cases pending hearings on his resolution to suspend all loans to railroads.

The report as of January 31 showed that of the loans authorized by the corporation $264,740 had been withdrawn or canceled, $48,275,529 remained at the disposal of borrowers, and $291,894,823 had been disbursed to them, of which $11,881,070 had been repaid. Only three applications for railroad loans had been received in January, although several have been filed since the end of the month. A list of all loans to railroads authorized by the corporation, included with its latest report, shows that the following loans which had been approved by the commission also had not been authorized by the corporation: Fonda, Johnstown & Gloversville, $170,387; Hoosac Tunnel & Wilmington, $23,600; Minneapolis & St. Louis, receiver, $2,698,630; Missouri & North Arkansas, receivers, $400,000; Savannah & Wilmington, receiver, $276,200; Stockton Terminal & Eastern, $40,750; Sumpter Valley, $68,500; White River, $16,000; Wisconsin & Michigan, $98,530.

Missouri Pacific Suspends A. T. C.

Acting on a petition of the Missouri Pacific, the Interstate Commerce Commission has suspended until further order the requirements of its automatic train-stop orders of 1922 and 1924 under which this road has been required to maintain automatic train-control between Leeds, Mo., and Osawatomie, Kan., 50 miles; between Poplar Bluff, Mo., and Texarkana, Tex., 243.5 miles, and between Jefferson City and Kansas City, Mo., 147.6 miles. (On all except the first 50 miles the company was subsequently excused from compliance.)

The National intermittent magnetic automatic train stop was placed in service on this road in July, 1925, between Leeds and Osawatomie; but the second order, requiring further installations, was suspended, in consideration of the action of the road in proceeding to install visual roadside block signals on 391 miles of its line. The application of the road, now presented, says that the A. T. C. system has given satisfactory service, but because of light traffic; the need of more freedom in assigning locomotives for long runs and the ample protection afforded by existing signaling (the centralized traffic control system), the cost of maintaining the automatic train stop is not justified. Compared with 1930, the total train movement in 1932 on this 50-mile section is less by about 25 per cent. There is but one scheduled meeting point between passenger trains on this section and few between freight trains. Of the 42 locomotives equipped, 12 are used every day on long runs, mostly over mileage not requiring A. T. C.

The Missouri Pacific has installed C. T. C. on 155 miles of line, in addition to the original 50-mile section; including the section between Kansas City and Atchison, 43 miles, single-track, a line over which the traffic is much heavier than on the 50-mile section; other installations have been made on double track lines. Under C. T. C. no accidents have occurred because of failure of enginemen to observe roadside signal indications and these installations have made costly double-tracking unnecessary, besides improving the average speed of trains. "Centralized traffic control accomplishes to some extent the functions of automatic train control." The director can observe to what extent enginemen are obeying signal indications.

Beginning with 1926, the road made extensive additions to its automatic visual roadside block signals, and the total of these is now 2,011 miles. In addition to this the installations of automatic interlocking plants and other improvements have brought the total capital account of expenditures on this work in the eight years ending 1931 to $5,764,000, exclusive of A. T. C. The road proposes to install automatic block signals as rapidly as funds will permit on 238 miles to complete the installation from St. Louis, Mo., to Pueblo, Colo., 905 miles.

The application names certain measures taken to promote safety; "a train order week," the first week in each month, during which officers are required to check train orders, to see if correct practice is kept up; a questionnaire for dispatchers, to enable them to keep constantly in mind the important rules; a similar reminder for telegraphers; educational letters on the occasion of train accidents, etc. Each night a certain rule is selected and termed "Rule for the Day;" and advice of this is sent out to all employees at midnight; this to encourage discussion; and operating officers seek to promote this discussion.

Recognizing all these improvements, the commission grants the request for suspension.

Rail Executives Heard in Depression Inquiry

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automobile, he said it would seem that by reduction in service this presents an opportunity to save perhaps 400 million dollars annually. Freight operation in 1931, he said, showed a profit of $1,043,129,901, whereas the passenger and allied services resulted in a loss of $92,133,257.

J. J. Pelley, president of the New York, New Haven & Hartford, on February 21 advocated a six-point program of legislation to improve the condition of the railroads and transportation generally, and W. W. Atterbury, president of the Pennsylvania, was to testify on February 25. Regulation of highway transportation was an important feature of Mr. Pelley's recommendations, but Mr. Loree, saying that he did not agree with many railroad officers on the subject, while he urged extension of regulation to all forms of carriers, said "it would not seem that control could be looked for through supervision of the traffic charges" of the trucks.

"If now we look for a remedy," Mr. Loree said, "we must point (1) to the excessively restrictive control imposed by national and state governments; (2) similar restrictions by the pressure of union labor organizations; and (3) fundamental and radical mechanical and economic changes that must, even in normal times, materially modify and divert demand, supply and means of transportation. The troubles in which we are now involved are not to be cured by poulticing, where the use of the knife is essential. We must face them with the attitude of the laboratory method. In an industry as far-flung and as diversified as is railroading, and one covering so long a period of development, the need for adjustments are apparent on every hand. Intelligently made, the railroads might rapidly assume their old-time efficiency and usefulness.

"To adapt the railroads to the changing conditions, we must, among other things, look to—

1. The adjustment of taxes, wages and working conditions.
2. Elimination of waste through the abandonment of all unused service, obsolete facilities and mileage no longer justified by the traffic.
3. The development of the essential railroad facilities to the highest state of efficiency through the improvement of grades, reduction of curves, shortening of lines, application of heavier rail and ballast, strengthening of bridges and improvement in equipment.
4. Amelioration of the five major hazards of the employee; i. e., sickness, accident, death, unemployment and superannuation, or the incapacity of old age.
5. The following are changes that it is suggested might be considered in a recasting of the Interstate Commerce Commission's activities:

(a) Extend regulation to all commerce and all carriers which the federal government has power to regulate.

(b) Separate the conflicting and inconsistent powers of prosecutor and judge, neither of which can be adequately exercised when both functions are in the same hands; vesting the former fully in the Interstate Commerce Commission, and leaving the latter to the courts.

(c) Omit Section 15a of the interstate commerce act, which, while affording less protection than the constitutional provision against confiscation, provides for recapture of so-called "excess earnings".

(d) Omit Section 19a, which provides for valuations. Although enacted on March 1, 1913, the valuations have not been completed and all work so far done is condemned by decisions of the Supreme Court.

(e) Omit the "commodities clause," Section 1 (8), which prevents any carrier from moving in interstate transportation any commodities, except timber and its products, in which it has an interest.

(f) Leave to the courts the power to award damages.

(g) Prevent the compulsory and misleading enhancement of operating expenses by including estimates of depreciation.

(h) Repeal the Hoch-Smith resolution.

(i) Remove restrictions upon control and operation of boats and other accessory services by railroads.

(j) Omit the power to fix rate divisions except when the commission has fixed a joint rate and the participating carriers are unable to agree.

In reply to questions by Senators Mr. Loree said that the Reconstruction Finance Corporation had kept some railroads out of the hands of receivers but that he was a good deal worried about the government's financial situation and recalled a time when government bonds were selling at 50 cents on the dollar in gold. He said he thought "we have pretty well exhausted our credit" and that it might be better to liberalize the requirements as to depreciation accounting than to continue advancing money from the R. F. C. He told the committee that the D. & H. had not discharged an employee "since this trouble began" although it has three or four hundred it could probably get along without. Asked about the policy of subsidizing aviation Mr. Loree said it is very important as a military policy that the government develop aviation as rapidly as possible and that it might subsidize the main routes but ought to stop subsidizing others.

Mr. Pelley advocated passage of S. 5551, the bankruptcy bill, with provision for railroad reorganization; modification of the anti-trust laws to permit maximum reduction in competitive waste; legislation covering the regulation of highway transpor-

tation; taking the government out of the Mississippi and Warrior river transportation service; regulation of water transportation; and repeal of the recapture and valuation provisions of the interstate commerce act. He said his company is engaged in all forms of transportation except by air and that as a highway operator he had learned that regulation is necessary in order to stabilize highway transportation and that regulated transportation cannot compete with or be properly co-ordinated with unregulated transportation. Asked his reaction to the report of the National Transportation Committee he said there were a number of good things in it and some he did not subscribe to but that on the whole it was a disappointment to him because it was not more specific and definite as to what ought to be done. Asked his opinion of the idea of a national transportation system he said he was in favor of co-ordination of transportation but that a single national transportation system would be impossible under private management and undesirable under government ownership.

William Randolph Hearst, in a statement before the committee on February 21, said that "apparently the only way that the necessary complete reorganization and unification of the railroads can be accomplished is through government ownership" and that "government ownership will administer the railroads economically in one co-ordinated system."

Small Risk for R. F. C. in Rail Loans, says Shoup

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theory advanced that inasmuch as the government is loaning so much money to the railroads it should take them over and I suppose in some unknown process of alchemy pay for them. As a matter of fact, the government has to date made loans to the railroads through the Reconstruction Finance Corporation of $226,000,000 or about one per cent of their total value, and has demanded and obtained adequate security therefor. The railroads have already repaid some twelve million dollars of the amount borrowed. It is safe to predict that they will not at the outside have to borrow from the government to three per cent of their total value in connection with this depression. And the government is charging a rate of interest much above that which it is charging for aid extended to steamship lines. This interest rate is I think perhaps one weak spot in the government program.

"The railroads will come back with certainty. All they need, as the report of the National Transportation Committee has shown, is an increase of about 20 per cent in their traffic to enable them to meet their fixed charges. They need equality of treatment with their competitors in respect to public control and regulation. As for the criticisms of their waste, I doubt if many lines of business in the United States can show less duplication of service or competitive waste.

"Railroad operations need intensive and close supervision, for they vary as the pulse of business varies in the United States, and must be responsive thereto. A closer acquaintance will quickly dissipate the conclusions of those who see great gains in one-man or regional control of railroads. Just now, what the railroads need is fair treatment in public control and regulation, and some temporary help as an offset to the fact that during the last ten years the United States has not made good on its obligation to establish rates that will give them a fair return on the valuation as determined by the Interstate Commerce Commission for that purpose.

"No one can question the good service they have given, or the great improvement it has been over that which obtained when they came back to private control. Their management has not been perfect, for perfection is that rare virtue that comes only after translation to another world. But they have given a real and satisfactory service. They have paid their stockholders dividends, and their bondholders interest. They have met obligations out of their treasuries for the public benefit imposed in like degree on no other enterprise. They have carried a great burden of taxation. They have gone forward notwithstanding the public has given great advantages to their unregulated competitors. They need to be allowed to meet competition by water or highway, wherever they find it, without interfering with their regulations to commerce elsewhere. Their managerial functions should not be usurped by public authority that necessarily cannot carry responsibility for results."

Construction

DELAWARE & HUDSON.—Plans, subject to approval by the New York Public Service Commission, are being prepared for the elimination of a grade crossing at Windsor crossing near Rouses Point, in Clinton county, N. Y., on the Champlain division of this road. Other plans, subject to approval by the D. & H., are being prepared for the elimination of a grade crossing on its line between Whallonsburg and Essex, N. Y., the last named work is to be carried out by the highway department of the State of New York.

ERIE.—The New York Public Service Commission has approved revised plans and specifications for the elimination of the Oak Hill avenue crossing of the Erie in Endicott, Broome county, N. Y. The commission also approved the bid of Parker & Graham, Clifton, N. J., the lowest submitted for the work.

PENNSYLVANIA.—A contract has been given to the Carmichael Construction Company, Akron, Ohio, for removing an existing two-span bridge and constructing a new three-span bridge to carry Park street, Akron, over the tracks of the Akron Union Passenger Depot Company, the Pennsylvania, the Baltimore & Ohio, and the Erie. The cost of the work will be about $24,000.

Supply Trade

The New York Air Brake Company, New York, on February 15 opened an office in the Midland Bank building, Cleveland, Ohio, with **L. W. Sawyer** and **G. A. Allen** as representatives at Cleveland.

F. C. Eibell, for the past four years manager of the advertising and publicity department of the **Worthington Pump & Machinery Corporation,** New York, has resigned. Mr. Eibell has held executive assignments on the staffs of three advertising agencies, two publishers and three manufacturers' advertising departments.

A. F. McCormick, formerly western sales agent of the J. G. Brill Company, Automotive division, has become associated with the **Clark Equipment Company,** Battle Creek, Mich., to handle sales of the Autotram aluminum stream-lined gas-mechanical rail car in the western territory, in co-operation with the company's territorial managers. Mr. McCormick, who has been identified with rail-motor-car development from its initial stages, was originally connected with the Service Motor Truck Company, Wabash, Ind., in the development of the first direct gas-powered rail car built by this company. In his new connection, Mr. McCormick's headquarters will be at Chicago, but he will work more or less directly out of the factory at Battle Creek, the central point for national sales.

American Brake Shoe & Foundry Company

Consolidated net earnings of $257,379 were reported by the American Brake Shoe & Foundry Company for the year ending December 31, 1932, as compared with net earnings of $1,386,000 for the previous year.

Among the constituent companies the operations of the Ramapo Ajax Corporation resulted in a 1932 net loss of $399,709 and those of the National Bearing Metals Corporation in a loss of $162,302. The consolidated balance sheet as of December 31, 1932, lists total current assets of $8,197,441 including $3,123,393 in cash, as against total current liabilities of $440,753.

Preferred and common stock dividends paid during the year totaled $1,201,307 which, together with another adjustment, reduced the surplus from $10,651,947, the December 31, 1931, figure, to $9,299,289 at the close of last year.

American Locomotive Company Annual Report

The American Locomotive Company, for the year ending December 31, 1932, reported a loss of $4,589,716 after depreciation and all other charges as compared with a 1931 loss of $3,929,384 and a profit of $3,778,558 in 1930. Plants of the Company were operated "at a very small percentage of capacity" last year, says the report which suggests that the answer to the present situation may be read in the statistics of railway expenditures for maintenance of equipment "combined with the absence of the purchase of any new railroad equipment."

Selected items from the consolidated in-

come and surplus accounts for the past two years are as follows:

	1932	1931
Net loss after deducting manufacturing, maintenance and administrative expenses	$3,145,124	$1,693,425
Depreciation on plants and equipment	1,444,592	1,641,971
Reserve for discount on Canadian exchange		593,988
Loss for the year	$4,589,716	$3,929,384
Dividends—Preferred stock	1,869,625	2,619,386
Common stock		767,900
Deficit after dividends	$6,459,341	$7,316,670

Dividends on the preferred stock were discontinued with the payment for the third quarter of 1932, disbursements on common stock having been discontinued in 1931. The balance sheet as of December 31, 1932, lists total current assets of $18,864,064 or $17,435,272 in excess of the total current liabilities of $1,428,792. Among the current assets cash alone amounted to $2,970,110 or more than double the current liability figure; cash and marketable securities together totaled $10,532,408.

The company shipped 24 new locomotives last year, 23 of which were carried over as unfilled orders at the beginning of the year. Of last year's consolidated sales, 64 per cent represented products of subsidiary companies, showing, the report says, "the growing importance of the diversification program of the Company."

In closing his remarks, William H. Woodin, chairman of the board, calls attention to the "enormous purchasing volume" which the railroads represent and urges the stockholders to "give support to any constructive remedial program, not only because of the benefit to the Company, but for patriotic reasons as well."

Pressed Steel Car Company

The year 1932 when "operations were only one per cent of normal" was the poorest in the history of the Pressed Steel Car Company, says the annual report for the year ending December 31 as it records last year's consolidated loss from operations amounting to $1,115,192. This operating deficit, which compares with a 1931 loss from operations of $1,046,276, does not take into consideration the $47,976 spent in 1932 for maintenance of equipment and buildings, nor the $158,511 depreciation charge. After all adjustments of last year, the report shows, the surplus and undivided profits fell from $13,436,657 on January 1, 1932, to $9,904,096 as of December 31.

The $158,511 depreciation charge, it is explained, is in accordance with the company's policy of making "heavy charges for depreciation and obsolescence in prosperous years and light charges when there is small use of plants and machinery." In former years, it is pointed out, annual charges for depreciation and maintenance have amounted to as much as $12,000,000 and $18,000,000.

The balance sheet, as of December 31, lists current assets of $3,331,994 including $952,436 cash, as against current liabilities of $784,116. There is, however, the company's 10-year five per cent convertible bonds which were due on January 1; pending negotiations in connection with arrangements to meet this maturity are discussed in the report.

The consolidated surplus and undivided profits account as of December 31, 1932, is as follows:

Surplus and Undivided Profits, January 1, 1932			$13,436,657
Results For Year 1932:			
Loss from operations		$1,115,192	
Interest on bond issues	$255,514		
Interest and discount received	200,034		
		55,480	
Loss on sale of United States of America Treasury bonds		131,813	
		$1,302,485	
Earnings from dividends on stocks and securities owned and other sources		72,800	
		$1,229,685	
ADD:			
Maintenance of buildings and equipment	$47,976		
Depreciation	158,511	206,487	1,436,171
			$12,000,485
ADD TO EARNED SURPLUS:			
Discount on parent company's securities purchased			403,610
			$12,404,095
DEDUCT FROM EARNED SURPLUS:			
Reserve for contingencies			$2,500,000
Surplus and Undivided Profits, December 31, 1932.			
Capital surplus		$3,388,154	
Earned surplus		6,515,941	$9,904,095

In his comment on prospects for future business President F. N. Hoffstot considers in detail the equipment situation on the railroads. His remarks are in part as follows:

During 1931 and 1932 practically all railroads were forced to economize drastically. With a surplus of equipment due to the falling off of traffic the natural and most logical thing to do was to use equipment until it needed repair and then place it on sidetracks and draw on the surplus. Later, when parts were urgently needed for equipment in operation, these stored cars were stripped of accessories and parts with the result that there is a larger number of bad order cars than is generally admitted. A survey of the car owned by the Class 1 railroads showed that they owned, at the end of 1930, 2,280,221 cars, of which 820,912 were over 20 years old. Of the number owned 1,060,240 were box cars and 381,486 of these were over 20 years old. In other words, 36 per cent of all the equipment owned by the Class 1 railroads in 1930 could be considered obsolete.

Retirements of freight train equipment by the Class 1 roads did not reach, in 1932, the average for the 10-year period from 1922 to 1931. While the exact figures are not available, from the information at hand it is evident that the retirements did not reach over 65,000 cars this year. The year 1931 was also below the average as only 78,671 cars were taken from service. The 10-year average previous to 1931 was 115,500 cars. The reduction in retirements is obviously accounted for by the drastic economies which the railroads were forced to on account of the depression. The present situation of the car equipment shows that the railroads, in the latter part of 1932, owned 2,237,840 cars, of which they reported 268,107 as being in bad order. At that time a surplus of 545,157 cars was reported, showing that 1,424,000 were in good order and in use on the railroads in the United States.

Inasmuch as car shortages have occurred when the car surplus was from 150,000 to 175,000 cars, (the distribution of this surplus being country-wide,) by subtracting this from the total surplus of 545,157 shows that the free surplus was about 400,000 cars in 1932. From this it can be seen that when 1,800,000 cars are in use the railroads will be very close to a shortage of equipment. The published statistics show that car loadings during the past year have been 54 per cent of the previous 8-year average. From this it can be readily seen, by a simple mathematical computation, that 1,424,000 cars being necessary to handle an average of only 54 per cent of the 8 years' total loadings, that 1,800,000 cars would handle, at the average proportion, 69 per cent of the years' average.

The above is based on the assumption that the five hundred odd thousand cars reported in good order are fit for revenue loading. The railroads have found, recently, that cars stored for the length of time that many of these cars have been stored, cannot be depended upon and as the corrosive action is very rapid, there have been many surprises to some of the leading railroads as to the condition of their equipment when they have found it necessary to sort out some good cars for special demand, such as for the coal demand this Fall when there was a period of cold weather. Many of the surplus cars referred to in the published reports have been stored since 1930 and many since early in 1931.

Replacement of obsolete equipment has been deferred by the carriers and the present situation is the culmination of conditions brought about by iniquitous regulation forced upon the railroads by Congress and the ruinous competition referred to elsewhere in this report. The problem of financing new purchases is one which the railroads will have to meet. Your Company, with others, joined in forming the Railroad Equipment Financing Corporation which has as members most of the leading railroad equipment manufacturers. The purpose of the Corporation is to furnish a medium through which, it is hoped, with Federal aid, railroads will be able to finance equipment purchases. With any worthwhile pick up in traffic, railways (when and as approval is given by proper government departments) will be able to purchase equipment without waiting for earnings to improve sufficiently their financial conditions before making purchases.

THE FLY IN THE OINTMENT FOR THE RAILROADS IS—the unfair competition of the Government in subsidized waterways and airways—unregulated motor competition, which are furnished free rights of way kept up at public expense.

THE FLY IN THE OINTMENT FOR THE CAR MANUFACTURING INDUSTRY IS—the railroads manufacturing new cars, the real cost of which is greater than if purchased from car manufacturers. If the railroads were out of the manufacturing business they would get cars at lower average costs and have less money tied up in fixed capital investments.

OBITUARY

Charles R. Lang, secretary of the National Waste Company, Chicago, died in that city on February 17.

Allan R. Rea, who retired as export manager of Fairbanks, Morse & Company, Chicago, in 1927, died in Hinsdale, Ill., on February 22.

James H. Jowett, executive vice-president and a member of the board of directors of the Ingersoll-Rand Company, New York, and of its affiliate company, the A. S. Cameron Steam Pump Works, died on February 16 at New York City after an illness of several months. Mr. Jowett was born 58 years ago and had

James H. Jowett

spent virtually his entire career with the Ingersoll-Rand Company. He entered its employ as a draftsman and rose successively through the positions of engineer, salesman, manager of the New York sales branch office, assistant general sales manager, and general sales manager until he was elected a vice-president and director. Mr. Jowett specialized on the development

of rock drilling equipment. He was a member of the American Society of Mechanical Engineers, the American Institute of Mining & Metallurgical Engineers, and a number of clubs including the Engineers Club.

Paul E. Carter, eastern manager of the General Railway Signal Company at New York, died on February 21 in Johns Hopkins Hospital, Baltimore, Md. Mr. Carter who was born in Detroit, Michigan, forty-seven years ago began his service with the General Railway Signal Company in 1908 on his graduation from Rensselaer Polytechnic Institute. He served in the World War as Captain with the thirty-fifth engineers returning to the General Railway Signal Company at the end of the war.

Equipment and Supplies

LOCOMOTIVES

THE DELAWARE, LACKAWANNA & WESTERN has ordered on approval two 600-hp. oil-electric locomotives—one from the Ingersoll-Rand Company and the other (to be equipped with a McIntosh & Seymour Diesel engine) from the American Locomotive Company.

PASSENGER CARS

THE MISSOURI-KANSAS-TEXAS is inquiring for four steel lounge cars.

THE CHESAPEAKE & OHIO has placed an order with the Pullman Car & Manufacturing Corporation for the installation of air-conditioning equipment in six passenger cars, including one lounge-dining car, two club dining cars, one salon coach and two dining cars. The air conditioning of these cars will lead to the installation of air-conditioning equipment in 25 Pullman cars for operation in the same trains.

IRON AND STEEL

THE CHICAGO, BURLINGTON & QUINCY is inquiring for 250 tons of structural steel for bridge repairs at Ottawa, Ill.

THE SOUTHERN PACIFIC has ordered 230 tons of structural steel for a bridge at Stockton, Cal., from the Moore Dry Dock Company.

NEW YORK CENTRAL. — The Arthur McMullen Company, New York, which has been awarded a contract to reconstruct this road's bridge No. 199 at Poughkeepsie, N. Y., has ordered 200 tons of steel for the work from the American Bridge Company.

SIGNALING

CHICAGO, ROCK ISLAND & PACIFIC.—Division 6 of the Interstate Commerce Commission has temporarily suspended the requirements of its automatic train-control orders so as to enable this company to discontinue the maintenance and operation of automatic train-control devices between Davenport, Ia., and Des Moines, 109.9 miles.

Financial

AKRON, CANTON & YOUNGSTOWN.—*R. F. C. Loan.*—This company has applied to the Reconstruction Finance Corporation for a loan of $325,000 to pay interest, taxes, and vouchers.

BALTIMORE & OHIO.—*Bond Maturity.*—This company has declared operative its plan for meeting the maturity of $63,250,000 of 20-year 4½ per cent bonds due March 1. Holders were asked to assent to payment of 50 per cent in cash and 50 per cent of 5 per cent refunding and general mortgage bonds, due in 1966, and more than 90 per cent agreed to do so.

CANADIAN PACIFIC.—*Dividend Action Deferred.*—Directors have deferred until next month action on both common and preferred dividends.

CHESAPEAKE BEACH.—*R. F. C. Loan.*—Division 4 of the Interstate Commerce Commission on February 18 approved a loan of $425,000 to this company from the Reconstruction Finance Corporation to aid it in financing the construction of an extension of its line by ferry service across Chesapeake Bay from Chesapeake Beach, Md., to Hudson. The company originally asked for $900,000 but later reduced its application. Commissioner Mahaffie dissented.

CHICAGO GREAT WESTERN.—*Bonds.*—The Interstate Commerce Commission has authorized this company to issue $2,100,000 of first mortgage, 50-year 4 per cent bonds to be pledged with the Railroad Credit Corporation as collateral security for a note.

DELAWARE, LACKAWANNA & WESTERN.—*Bonds.*—The Interstate Commerce Commission has authorized this company to pledge with the Railroad Credit Corporation as security for a loan of $1,000,000 the following bonds: $1,193,000, Oswego & Syracuse, 5 per cent, first mortgage, series A; $443,000, Valley R. R., 5 per cent first and refunding series A; and $207,000, Greene R. R., 5 per cent first and refunding, series A.

GULF, MOBILE & NORTHERN.—*R. F. C. Loan.*—This company has applied to the Reconstruction Finance Corporation for a loan of $500,000 to meet various outstanding obligations.

MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE.—*R. F. C. Loan.*—Division 4 of the Interstate Commerce Commission has approved this company's application for an extension for a further term of two years of its one-year loans from the Reconstruction Finance Corporation aggregating $1,814,000 now outstanding in the amount of $1,499,461.

MINNESOTA WESTERN.—*Stock.*—Pursuant to a decree of foreclosure of the federal court the property formerly operated by the Minnesota Western R. R. was sold to the Pence Automobile Company on August 22, 1932, for the upset price of $100,000. The new company, the Minnesota Western Ry., is now authorized by the Interstate Commerce Commission to issue $100,000 of common stock to be delivered to the Automobile Company in full payment for the property.

MISSOURI PACIFIC.—*R. F. C. Loan.*—This company has applied to the Reconstruction Finance Corporation for an additional loan of $3,921,191 and also for $1,300,000 for which it recently applied but which has not yet been authorized, to meet requirements for interest, principal of maturing bonds, equipment trust certificates, and taxes. On the latest application for $4,300,000 the commission approved a loan of $3,800,000 in January and the corporation authorized $3,000,000 of the amount to meet interest requirements on February 1.

ST. LOUIS-SAN FRANCISCO.—*Abandonment.*—The receivers have applied to the Interstate Commerce Commission for authority to abandon the operation of the Stanley branch, from Olathe, Kan., to Stanley, 8.4 miles.

ST. LOUIS-SAN FRANCISCO.—*Foreclosure.*—Holders of prior lien bonds of the St. Louis-San Francisco have filed notice in the federal district court of St. Louis of intention to institute foreclosure suit against the railroad. The notice, which was filed by attorneys representing the Central Hanover Bank & Trust Company, New York, and Daniel K. Catlin of St. Louis, alleges that the railroad has defaulted in its interest and, inasmuch as the railroad property is now in the possession of the court through its receivers, asks leave to file a bill of complaint for enforcement of their rights.

ST. LOUIS SOUTHWESTERN.—*R. F. C. Loan.*—Division 4 of the Interstate Commerce Commission on February 16 approved an additional loan of $832,550 from the Reconstruction Finance Corporation, to be used in payment of obligations maturing from February to June.

SAN DIEGO & ARIZONA EASTERN.—*Acquisition of San Diego & Arizona.*—Effective February 1, all the properties of the San Diego & Arizona were transferred to the San Diego & Arizona Eastern, which will continue their operation.

SANTA FE NORTHWESTERN.—*R. F. C. Loan.*—This company has applied to the Reconstruction Finance Corporation for a loan of $228,000.

SAVANNAH & STATESBORO.—*Abandonment.*—The receiver has been authorized by the Interstate Commerce Commission to abandon as to interstate and foreign commerce this entire 35-mile line between Cuyler, Ga., and Statesboro.

SEABOARD AIR LINE.—*Abandonment.*—The receivers of the Raleigh & Charleston have been authorized by the Interstate Commerce Commission to abandon that part of the company's line from Lumberton, N. C., to a point near Lakeview, S. C., 22.7 miles.

SOUTHERN PACIFIC.—*R. F. C. Loan.*—This company has applied to the Reconstruction Finance Corporation for a "work loan" of $1,200,000 for the construction of a passenger station at Houston, Tex.

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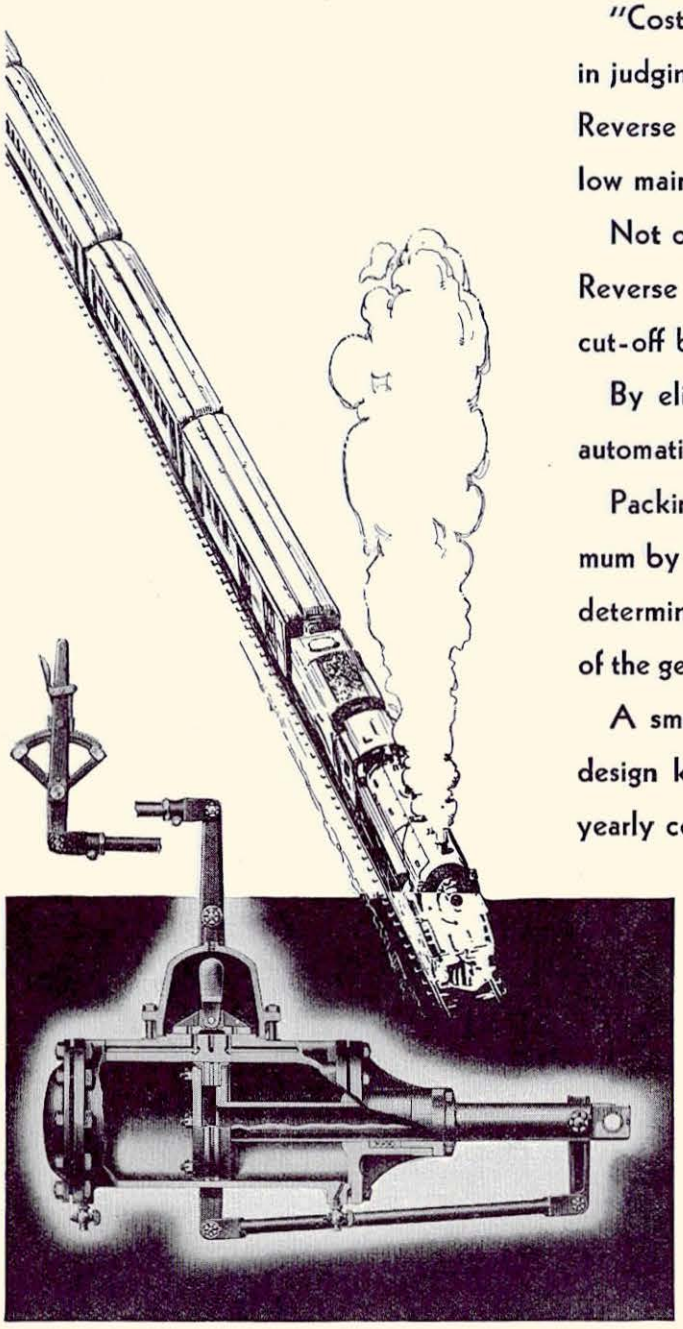
What Do REVERSE GEARS COST "PER YEAR"?



"Cost-per-year" is one very important yard stick to use in judging a power reverse gear. Franklin Type "E" Power Reverse Gear, the first of its kind, has a ten year record of low maintenance.

Not only does the quick-acting Franklin Type "E" Power Reverse Gear make it easy to obtain and keep the desired cut-off but it does so at a minimum of expense.

By elimination of the cross-head much repair expense is automatically avoided.

Packing—another large item of repairs is kept at a minimum by the self-inspection feature that makes it possible to determine the condition of the packing without disassembly of the gear.

A small number of wearing parts and unique features of design keep maintenance at a mimimum, resulting in a low yearly cost for this gear.

Franklin Type "E" Power Reverse Gears are designed for accurate control of modern power at a minimum of expense. Specify them.

THE FRANKLIN SLEEVE JOINT
Uses flat gaskets—the cheapest to buy when replacement is necessary.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.
NEW YORK CHICAGO MONTREAL

SOUTHERN PACIFIC.—*Abandonment of Peninsular Ry.*—The Interstate Commerce Commission has authorized the Peninsular Ry. to abandon (1) a 6.8-mile line from San Jose, Calif., to Monta Vista, (2) a 7-mile line from Meridian to Congress Springs, and (3) a 5.5-mile line from Saratoga to Rinconada station (Los Gatos), and to abandon operation of 13.1 miles between Congress Junction and Mayfield.

TALLULAH FALLS.—*Abandonment.*—This company has applied to the Interstate Commerce Commission for authority to abandon its entire line from Cornelia, Ga., to Franklin, N. C., 57.1 miles.

TRINITY VALLEY & NORTHERN.—*Abandonment.*—The Interstate Commerce Commission has authorized this company to abandon, as to interstate and foreign commerce, its 5.2-mile line extending from Dayton, Tex., to Fullerton.

VICKSBURG BRIDGE & TERMINAL COMPANY.—*R. F. C. Loan.*—Division 4 of the Interstate Commerce Commission on February 18 denied approval of this company's application for a loan of $4,000,000 from the Reconstruction Finance Corporation on the ground that it is not now eligible to obtain a loan as a railroad engaged in interstate commerce and does not intend to take steps to qualify it as such unless and until the loan is granted. At the same time the commissioners denied the company's application for a certificate authorizing its operation as a railroad under a plan by which the Yazoo & Mississippi Valley, which now operates over its property under lease, would operate as agent instead. The report said it was admitted that the moving consideration in the plan was that it might be placed in a position to secure a loan but that the common carrier status would be, in any event, merely a technical one.

Tentative Valuation Reports

The Interstate Commerce Commission, Division 1, has issued tentative valuation reports stating the final value for rate-making purposes of the property owned and used for common-carrier purposes as of the respective valuation dates as follows:

Flint Belt	$970,000	1927
Baltimore & Eastern	740,000	1927
Patapsco & Back Rivers	1,700,000	1927
Alameda Belt Line	730,000	1928
Trona	880,000	1927
Westfield	230,000	1927

Average Prices of Stocks and of Bonds

	Feb. 21	Last week	Last year
Average price of 20 representative railway stocks	24.07	25.43	31.59
Average price of 20 representative railway bonds	54.81	57.18	69.46

Dividends Declared

Bangor & Aroostook.—Common, 50c, quarterly; preferred, $1.75, quarterly, both payable April 1 to holders of record February 28.

Canadian Pacific.—Preferred, $2.00, semi-annually. The Directors deferred consideration of preferred dividend until the March meeting.

Chesapeake & Ohio.—Common, 62½c, quarterly, payable April 1 to holders of record March 8; Preferred, $3.25, semi-annually, payable July 1 to holders of record June 8.

Chestnut Hill.—75c, quarterly, payable March 4 to holders of record February 20.

Vicksburg, Shreveport & Pacific.—Preferred 2½ per cent, semi-annually; Common, 2½ per cent, semi-annually, both payable April 1 to holders of record March 10.

Railway Officers

EXECUTIVE

George D. Brooke, vice-president and general manager of the Chesapeake & Ohio, with headquarters at Richmond, Va., has relinquished the position of general manager and has been elected also vice-president of the New York, Chicago & St. Louis (the Nickel Plate). **F. M. Whitaker,** vice-president in charge of traffic of the Chesapeake & Ohio, has been elected also vice-president of the Nickel Plate, with headquarters as before at Cleveland. **F. D. Groff,** chief clerk on the C. & O., has been appointed assistant to the president of the C. & O., the Nickel Plate and the Pere Marquette.

Barret Conway, assistant secretary and assistant treasurer of the Chicago & North Western, has been elected vice-president and secretary, with headquarters as before at Chicago, to succeed **John D. Caldwell,** whose death was reported in the *Railway Age* of February 11. Mr. Conway has been with the North Western for 33 years. He was born on November 14, 1878, at St. Louis, Mo., and attended Westminster College at Fulton, Mo., entering railway service in 1900 in the office of the general superintendent of the Chicago & Alton at Chicago. After six months with this company Mr. Conway went with the North Western as a stenographer in the office of the general manager at Chicago. Two years later he was transferred to the president's office and in 1910 he was made assistant secretary. He remained in the latter capacity until 1928, when he was elected also assistant treasurer. Thereafter he served as assistant secretary and assistant treasurer until his recent appointment.

Barret Conway

Samuel H. Cady, general solicitor of the Chicago & North Western, has been elected vice-president and general counsel, with headquarters as before at Chicago, to succeed **Ray N. Van Doren,** who died on January 12, as noted in the *Railway Age* of January 21. Mr. Cady has been connected with the legal department of the North Western for 12 years. He was born on February 4, 1870, at Excelsior, Wis., and received his LL.B. degree from the University of Wisconsin in 1897. From that year until 1921, Mr. Cady engaged in the practice of law as a member of the firm of Cady, Strehlow & Kaftan at Green Bay. In the latter year he was appointed Wisconsin attorney for the North Western, with headquarters at Milwaukee, Wis., and in 1924, he became assistant general solicitor, with headquarters at Chicago. In June, 1925, Mr. Cady was promoted to general solicitor, which position he continued to hold until his recent appointment.

Samuel H. Cady

Harry W. Dorigan, who was recently appointed assistant to vice-president of the New York, New Haven & Hartford, as announced in the *Railway Age* of February 11, page 225, was born at Taunton, Mass., on November 23, 1895. Mr. Dorigan entered railroad service with the New Haven immediately after graduation from high school. He commenced his career as a clerk in the auditor of disbursements' office at New Haven, Conn. Subsequently he was transferred to the operating department, working in the office of the superintendent of the Old Colony division at Taunton, Mass., and later in the general superintendent's office at Boston. In 1916, he returned to the auditor of disbursements' office at New Haven. Following

Harry W. Dorigan

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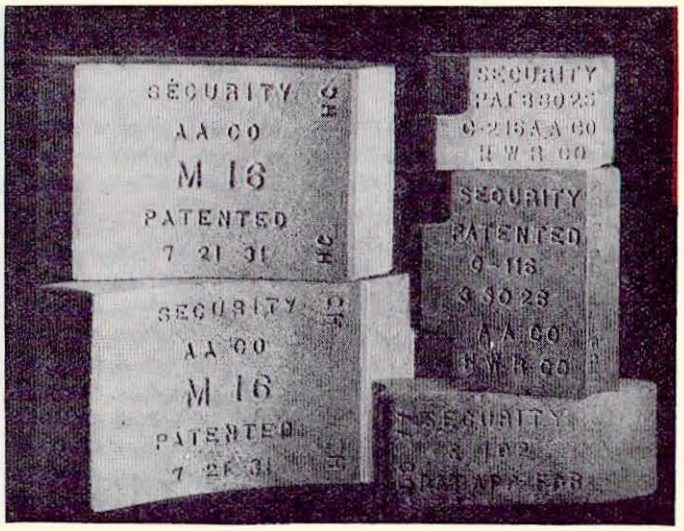
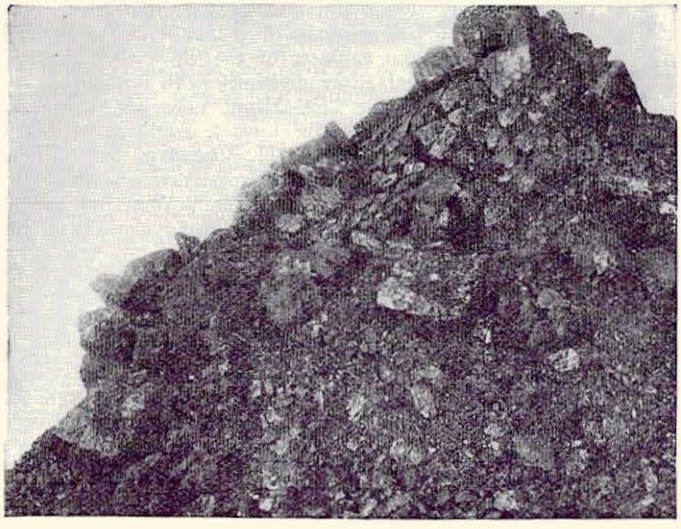


For Lack of

$1.00 Worth of ARCH BRICK



$10.00 Worth of FUEL *Was Lost*

●

There are places where the only way to save money is to spend it.

The locomotive Arch is one such instance. Over-enthusiastic efforts at economy that clip the last course from the Arch mean that for every $1.00 thus saved, $10.00 is automatically added to the fuel bill.

The fuel economy of the locomotive Arch was thoroughly established 20 years ago. In these days when every dollar of expense is under fire, equip the Arch to save every dollar of fuel money.

HARBISON-WALKER REFRACTORIES CO.
Refractory Specialists

AMERICAN ARCH CO.
INCORPORATED
Locomotive Combustion Specialists › › ›

18 months overseas war service he returned in 1919 to special accounting work in the auditor of disbursements' office. In 1921 he was promoted to division accountant of the New London division, and in 1923 he was transferred as division accountant at Providence, R. I. In 1925 he returned to New Haven in the office of the comptroller, working as special accountant, statistical accountant, and then as assistant to comptroller, the position he held until his recent promotion.

FINANCIAL, LEGAL AND ACCOUNTING

R. G. Eberly, assistant treasurer of the New York, Chicago & St. Louis, has been promoted to treasurer, with headquarters as before at Cleveland, Ohio, succeeding **L. B. Williams.**

W. G. Van De Water, secretary and treasurer of the Delaware, Lackawanna & Western retired on February 21, and **J. G. Enderlin,** assistant secretary and assistant treasurer has been elected to Mr. Van De Water's former position.

William F. White, assistant to the general auditor of the Chicago & North Western, has been promoted to assistant secretary and assistant treasurer, with headquarters as before at Chicago, succeeding **Barret Conway,** who has been elected vice-president and secretary. **H. H. Small,** chief clerk in the office of the vice-president and secretary, has been appointed to the newly-created position of assistant treasurer, with headquarters also at Chicago.

OPERATING

A. T. Lowmaster, general superintendent of transportation of the Chesapeake & Ohio, with headquarters at Richmond, Va., has been promoted to general manager, succeeding **George D. Brooke,** vice-president and general manager, who retains the title of vice-president.

W. C. Baisinger, who has been appointed superintendent of the Oklahoma division of the Atchison, Topeka & Santa Fe, with headquarters at Arkansas City, Kan., as noted in the *Railway Age* of February 4, has spent most of his service in the engineering department of this road. He was born on November 8, 1885, at Eaton, Ind., and graduated from the college of engineering of Purdue University, Lafayette, Ind. He first entered the service of the Santa Fe in 1907, as a masonry inspector at Galesburg, Ill., and after serving in various positions in the engineering department, was appointed division engineer of the Southern Kansas division at Chanute, Kan., in March, 1913. Two years later he was transferred to the Missouri division at Marceline, Mo., and in March, 1917, he was sent to Chicago as assistant engineer. In November of the same year Mr. Baisinger was promoted to office engineer at Chicago, being appointed roadmaster on the Eastern division at Ottawa Jct., Kan., two years later. From November, 1922, until April, 1923, he served as district engineer of the Eastern district of the Eastern lines, with headquarters at Topeka, Kan., and on the latter date he was transferred to the operating department as assistant superintendent of the Oklahoma division, at Arkansas City. Mr. Baisinger retained the latter position until his recent promotion to superintendent, effective February 1.

W. C. Baisinger

TRAFFIC

L. P. Harrell, chief clerk to the coal traffic manager of the Norfolk & Western, has been appointed assistant manager of the coal department, effective March 1.

W. J. Gillerlain, traveling passenger agent for the Norfolk & Western, at Chicago, has been appointed to the newly-created position of western passenger agent with the same headquarters.

V. H. Richardson, assistant general passenger agent of the Southern Pacific of Mexico, has been appointed freight claim agent, with headquarters as before at Guadalajara, Jalisco, succeeding **A. T. Davis.**

John C. Pollock, city passenger agent for the Union Pacific, with headquarters at Chicago, has been appointed manager of the Chicago & North Western-Union Pacific department of tours, with the same headquarters.

R. B. Williamson has been appointed district manager of a new coal bureau which the Norfolk & Western has opened at Boston, Mass. **George O. Ellstrom** has been appointed district manager of that railroad's coal bureau at Winston-Salem, N. C., Mr. Williamson's former position.

R. M. Paisley, general freight and passenger agent of the Pittsburgh & West Virginia, has been appointed to the newly-created position of traffic manager in charge of rates and revisions, with headquarters as before at Pittsburgh, Pa. **R. W. Bramwell,** general eastern agent, with headquarters at New York, has been appointed to the newly-created position of traffic manager in charge of solicitation, with headquarters at Pittsburgh. In these positions, Mr. Paisley and Mr. Bramwell will assume the duties formerly handled by **J. C. Gross,** assistant general traffic manager, deceased.

ENGINEERING AND SIGNALING

T. H. Strate, engineer of track elevation of the Chicago, Milwaukee, St. Paul & Pacific, has been appointed division engineer of the Chicago Terminal and Terre Haute divisions, with headquarters as before at Chicago, and the position of engineer of track elevation has been abolished. **H. Wuerth,** division engineer of the Chicago Terminal division, has been transferred to the Iowa & Dakota division, with headquarters at Mason City, Iowa, where he succeeds **M. A. Bost,** who has been assigned to other duties. **E. H. Pfafflin,** division engineer of the Terre Haute division, with headquarters at Terre Haute, Ind., has also been assigned to other duties. **E. H. Johnson,** division engineer of the Iowa & Southern Minnesota division, with headquarters at Austin, Minn., has been transferred to the Dubuque & Illinois and the Kansas City divisions, with headquarters at Savanna, Ill., where he succeeds **R. A. Whiteford,** who has been assigned to other duties. The position of division engineer at Austin has been abolished and **A. Daniels,** division engineer of the Twin City Terminal and River divisions, with headquarters at Minneapolis, Minn., now has jurisdiction also over the Iowa & Southern Minnesota division. **W. H. Vosburg,** division engineer of the La Crosse division, with headquarters at La Crosse, Wis., has had his jurisdiction extended to include the River division.

OBITUARY

J. C. Gross, assistant general traffic manager of the Pittsburgh & West Virginia, with headquarters at Pittsburgh, Pa., died suddenly on January 27.

Albert J. Simmons, eastern passenger agent of the Lehigh Valley, died on February 23, at his home in New York. Mr. Simmons had been ill for about two years.

T. M. Collins, supervisor of land appraisals of the Bessemer & Lake Erie, the Duluth, Missabe & Northern, the Elgin, Joliet & Eastern, and the Union Railroad Company, died at Pittsburgh, Pa., on February 3.

Peter M. Newman, president of the Susquehanna & New York, the Tionesta Valley and the Clarion River, died at Williamsport, Pa., on February 15, at the age of 71 years.

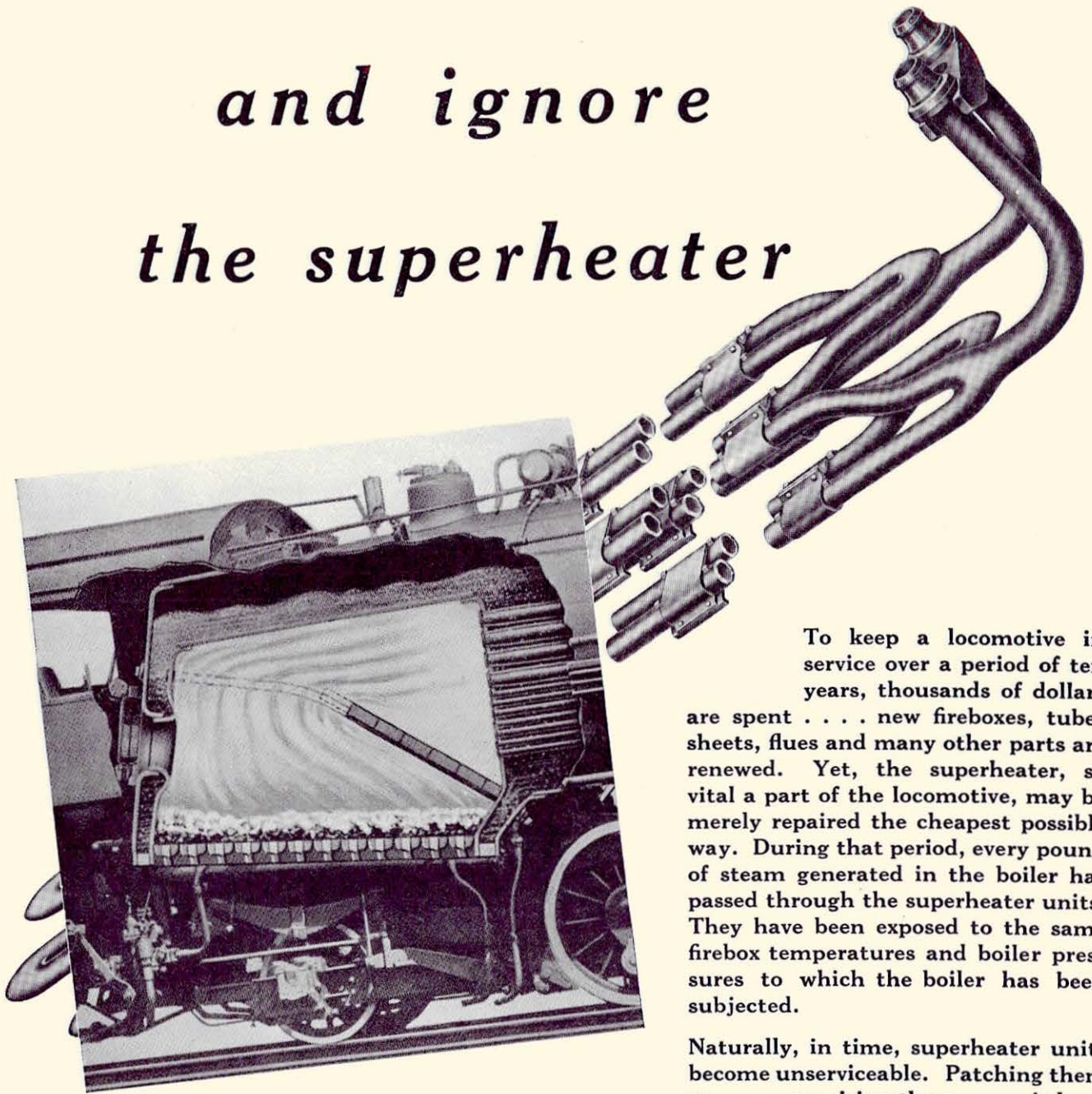
Sidney F. Andrews, assistant director general of the United States Railroad Administration, and formerly assistant general solicitor of the Illinois Central, died at Washington on February 16.

A WELL DRILLED by the Chesapeake & Ohio in Huntington, W. Va., for fuel supply for its shops is estimated to have a capacity of 850,000 cu. ft. of gas daily. The production of this well, together with that of another well previously drilled, will be sufficient to meet the shops' fuel needs. The first well produces about 1,500,000 ft. of gas daily.

DO NOT RENEW FIREBOXES

and ignore

the superheater



To keep a locomotive in service over a period of ten years, thousands of dollars are spent . . . . new fireboxes, tube-sheets, flues and many other parts are renewed. Yet, the superheater, so vital a part of the locomotive, may be merely repaired the cheapest possible way. During that period, every pound of steam generated in the boiler has passed through the superheater units. They have been exposed to the same firebox temperatures and boiler pressures to which the boiler has been subjected.

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